



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**01.12.2021 Bulletin 2021/48**

(51) Int Cl.:  
**E21B 7/20 (2006.01)** **E21B 19/08 (2006.01)**  
**E21B 19/16 (2006.01)**

(21) Application number: **20206851.6**

(22) Date of filing: **14.06.2017**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

(30) Priority: **23.09.2016 US 201615273895**

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:  
**17853576.1 / 3 482 030**

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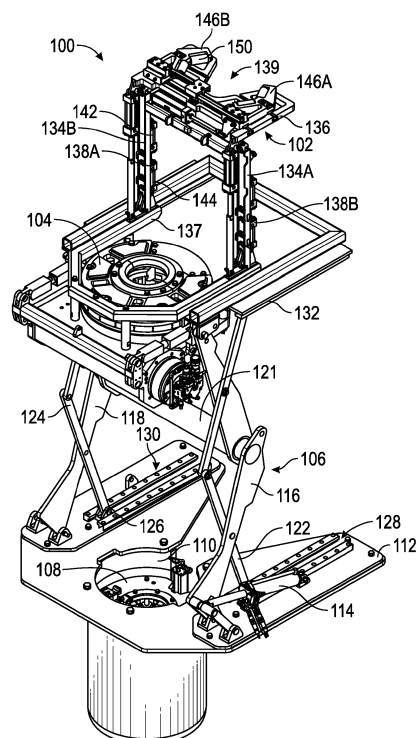
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Remarks:

This application was filed on 11.11.2020 as a divisional application to the application mentioned under INID code 62.

(54) **INTEGRATED TUBULAR HANDLING SYSTEM**

(57) A tubular handling system and method, of which the tubular handling system includes a power tong configured to engage and rotate an add-on tubular by applying a torque thereto, the power tong defining a central opening configured to receive the add-on tubular there-through, a spider disposed at a rig floor, the spider being configured to support a tubular string, a lifting assembly coupled with the power tong and configured to move the power tong vertically with respect to the tubular string and the spider, and a torque-measuring device configured to measure a reactionary torque transmitted from the power tong to the lifting assembly.



**FIG. 1**

## Description

### Cross-Reference to Related Applications

**[0001]** This application claims priority to U.S. Patent Application having Serial No. 15/273,895, which was filed on September 23, 2016 and is incorporated by reference herein in its entirety.

### Background

**[0002]** Tubular handling equipment is used on an oil rig to make up and lower casing and other tubulars into the wellbore ("trip-in"). During trip-in, an elevator picks up a length of one or more joints of tubular from a rack and brings the tubular into position above a "stump" or open connection of a previously-run tubular. The stump is typically supported at the rig floor by a spider, which supports the weight of the deployed tubular string at the rig floor. An operator may then guide the new length of tubular (an "add-on" tubular) into position over the stump (i.e., at well center). The operator may then assist in stabbing the add-on tubular into the open connection of the stump.

**[0003]** Once this occurs, the operator may engage a power tong onto the new tubular to make-up the add-on tubular to the string via the power tong. The torque applied by the power tong causes the new tubular to rotate into connection with the stump. The stump is generally held rotationally stationary by a backup tong. The elevator may then engage the new tubular, after the new tubular is made up to the remainder of the string, and the spider may disengage from the tubular string, leaving the weight of the tubular string to be supported by the elevator. The elevator may then lower the tubular string into the well, until nearing the rig floor, at which point the spider may be re-engaged, and the process starts again.

**[0004]** This is typically a labor-intensive process and generally includes one or more workers exposed at the rig floor and manually handling extremely heavy machinery.

### Summary

**[0005]** Embodiments of the disclosure may provide a tubular handling system that includes a power tong configured to engage and rotate an add-on tubular by applying a torque thereto, the power tong defining a central opening configured to receive the add-on tubular there-through, a spider disposed at a rig floor, the spider being configured to support a tubular string, a lifting assembly coupled with the power tong and configured to move the power tong vertically with respect to the tubular string and the spider, and a torque-measuring device configured to measure a reactionary torque transmitted from the power tong to the lifting assembly.

**[0006]** Embodiments of the disclosure may also provide a method for handling tubulars, the method including

supporting a tubular string using a spider of a tubular handling assembly. A power tong of the tubular handling system is disposed around the tubular string, the tubular handling system further including a lifting assembly in a collapsed configuration. The method also includes moving the power tong upwards along the tubular string, past an upper connection thereof, and around an add-on tubular to be connected to the tubular string, by expanding the lifting assembly and without laterally moving the power tong from around the tubular string. The method further includes rotating the add-on tubular using the power tong, to connect a lower connection of the add-on tubular to the upper connection of the tubular string, such that the add-on tubular becomes part of the tubular string, disengaging the power tong from the add-on tubular, lowering the power tong past the lower connection of the add-on tubular and the upper connection of the tubular string by collapsing the lifting assembly, without laterally moving the power tong from around the tubular string, such that the power tong is positioned proximal to the spider, disengaging the spider from the tubular string, and lowering the tubular string, including the add-on tubular, through the spider and the power tong.

**[0007]** The foregoing summary is intended merely to introduce a subset of the features more fully described of the following detailed description. Accordingly, this summary should not be considered limiting.

### Brief Description of the Drawings

**[0008]** The accompanying drawing, which is incorporated in and constitutes a part of this specification, illustrates an embodiment of the present teachings and together with the description, serves to explain the principles of the present teachings. In the figures:

Figure 1 illustrates a perspective view of a first tubular handling system, according to an embodiment.

Figure 2 illustrates a perspective view of a power tong of the tubular handling system, according to an embodiment.

Figure 3 illustrates a perspective view of the power tong with a top guard thereof removed, according to an embodiment.

Figure 4 illustrates a perspective view of the power tong with the top guard and a cage plate thereof removed, according to an embodiment.

Figure 5 illustrates a perspective view of a rotary with a spider disposed therein, according to an embodiment.

Figure 6 illustrates a perspective view of a support can with a spider disposed therein, according to an embodiment.

Figure 7A illustrates a perspective view of pipe-gripping slips in a disengaged position, according to an embodiment.

Figure 7B illustrates a perspective view of the pipe-gripping slips in an engaged position, according to

an embodiment.

Figure 8 illustrates a perspective view of a bottom of the spider, according to an embodiment.

Figure 9 illustrates a perspective view of a second tubular handling system in an expanded configuration, according to an embodiment.

Figure 10 illustrates another perspective view of the second tubular handling system, according to an embodiment.

Figure 11 illustrates a perspective view of the second tubular handling system in a collapsed configuration, according to an embodiment.

Figure 12 illustrates a perspective view of a third tubular handling system, according to an embodiment.

Figure 13 illustrates a perspective view of a fourth tubular handling system, according to an embodiment.

Figure 14 illustrates a side view of the fourth tubular handling system, according to an embodiment.

Figure 15A illustrates a perspective view of a fifth tubular handling system, according to an embodiment.

Figure 15B illustrates a side view of the fifth tubular handling system, according to an embodiment.

Figure 16 illustrates a flowchart of an embodiment of a method for handling tubulars, according to an embodiment.

Figures 17A, 17B, 17C, 17D, 17E, and 17F illustrate views of an example of a tubular handling system during various stages of the method of Figure 16, according to an embodiment.

**[0009]** It should be noted that some details of the figure have been simplified and are drawn to facilitate understanding of the embodiments rather than to maintain strict structural accuracy, detail, and scale.

## Detailed Description

**[0010]** Reference will now be made in detail to embodiments of the present teachings, examples of which are illustrated in the accompanying drawings. In the drawings, like reference numerals have been used throughout to designate identical elements, where convenient. In the following description, reference is made to the accompanying drawing that forms a part thereof, and in which is shown by way of illustration a specific exemplary embodiment in which the present teachings may be practiced. The following description is, therefore, merely exemplary.

**[0011]** In general, the present disclosure provides a tubular handling system that includes a spider, a power tong, a lifting assembly for the power tong, and a boxing device. These components are configured to operate in concert to reduce manual manipulation of the various pieces of equipment used to handle, make-up, and support the tubular string being run. The assembly provides for reliable acceptance and positioning of a new or "add-

on" tubular, using the boxing device, while the spider holds the "stump" (i.e., previously-run tubular string) at the rig floor.

**[0012]** The power tong has retractable jaws, allowing it to be lifted above the stump, past the tubular connections, centralizers, and other tools that may be attached to the tubulars, and into engagement with the add-on tubular. In at least some embodiments, the power tong of the assembly is movable vertically past the connections of the tubular string, and thus may not need to be moved laterally onto and off of the tubular string when new tubulars are added. The power tong is then employed to rotate the new tubular, such that the new tubular is threaded into the stump. Reactionary torque of the power tong is supported either by a spider with torque-holding capacity or by a backup tong incorporated into the system. The assembly then collapses to allow the elevator to lower the tubular string through the power tong and the spider into the well, and then the spider re-engages the tubular string once the elevator and string have been lowered.

**[0013]** Turning now to the illustrated embodiments, Figure 1 depicts a raised perspective view of a first tubular handling system 100, according to an embodiment. The system 100 includes a boxing device 102 for positioning an add-on tubular above a well center, a power tong 104 for rotating and applying torque to the add-on tubular, which is received through the central opening thereof, a lifting assembly 106 for lifting the power tong 104, and a spider 108 received into a rotary 110 connected to a rig floor. The rotary 110 may be a rotary table or a rotary bushing positioned within the opening of the rotary table. The system 100 may be configured to support running of any type of tubular, such as casing, drill pipe, completion tubing, or the like. For convenience, the system 100 will be described herein with reference to casing, which may be lowered via one or more elevators, with each joint (or a stand thereof) being hoisted and moved into position by a secondary (e.g., "single joint") elevator. It will be appreciated though that this system 100 may be readily applied to other drilling operations.

**[0014]** In an embodiment, the lifting assembly 106 includes a base plate 112, which may be secured to the rotary 110. The lifting assembly 106 may also include one or more structures configured to raise the power tong 104 with respect to the base plate 112 (and/or with respect to the rotary 110). In the illustrated embodiment, the lifting assembly 106 may include a linear actuator 114, such as, for example, a hydraulic actuator, for this purpose. The linear actuator 114 may be linked with lifting arms 116, 118. The lifting arms 116, 118 may be pivotally connected to guide arms 122, 124, respectively, and pivotally connected to the base plate 112. Further, the lifting arms 116, 118 may be connected together via a cross-member 121, such as a cylindrical bar or tube (as shown), which may prevent twisting of the lifting arms 116, 118.

**[0015]** The guide arms 122, 124 may include slidable feet 126, which may be disposed in a channel 128, 130,

thereby controlling the lifting of the lifting assembly 106. At the top side, the lifting assembly 106 may include a lifting frame 132, which may be coupled with the lifting arms 116, 118, the guide arms 122, 124, the power tong 104, and the boxing device 102. Slidable feet may also be provided at the pivoting connection between the guide arms 122, 124 and the lifting frame 132. Accordingly, actuation (i.e., extension or retraction) of the linear actuator 114 may be translated into vertical movement of the lifting frame 132, and thus vertical movement of the boxing device 102 and the power tong 104. In an embodiment, the lifting assembly 106 may be movable from a collapsed configuration, in which the lifting arms 116, 118 are pivoted together and positioned at or near the base plate 112, to an expanded configuration, in which the lifting arms 116, 118 extend upwards, e.g. such that the lower portion of the lifting arms 118 forms an angle of between about 45 degrees and about 80 degrees with respect to the base plate 112. Further, the lifting assembly 106 may be configured to hold the power tong 104 at a range of elevations above the spider 108, between the expanded and collapsed configurations.

**[0016]** Although described and illustrated as a type of scissor-jack arrangement, it will be appreciated that the lifting assembly 106 may, in some embodiments, take on other forms of kinematic linkage lifting mechanisms. Moreover, it will be appreciated that the linear actuator 114 may be substituted or augmented with any suitable type of actuator, and one or more additional actuators 114 (e.g., an actuator attached directly to the lifting arm 118) may be employed.

**[0017]** Turning now to the boxing device 102 positioned above the power tong 104, the boxing device 102 may include two or more arms 134A, 134B, an upper frame (e.g., a plate) 136, and a base 137. The base 137 may be coupled with the lifting frame 132 and/or the power tong 104. The arms 134A, 134B may be pivotally coupled with the base 137 and the upper frame 136.

**[0018]** Further, the boxing device 102 may include one or more actuators (two are shown: 138A, 138B, one along each arm 134A, 134B, respectively), which may be pivotally coupled with the upper frame 136 and the base 137. The actuators 138A, 138B may either or both be hydraulic, pneumatic, electric, etc. In an embodiment, each actuator 138A, 138B may include a primary actuator 142 and a secondary actuator 144. The upper frame 136 may form a recess 139, which may be configured to laterally receive a tubular (e.g., casing), as will be described in greater detail below.

**[0019]** In operation, the boxing device 102 may move between a collapsed configuration and an expanded configuration by operation of the linear actuator 138A, 138B. For example, in the collapsed configuration, the boxing device 102 may have a minimal vertical height, e.g., the arms 134A, 134B may be pivoted toward the lifting frame 132, e.g., by retraction of the linear actuator 138A, 138B, and the upper frame 136 may accordingly rest at or near the lifting frame 132. The boxing device 102 may also

have a neutral or "well centered" position, in which the boxing device 102 is configured to center a tubular received into the recess 139 on the well, as will be described in greater detail below.

**[0020]** The boxing device 102 may also include grippers 146A, 146B, which may be movable along the upper frame 136, e.g., under force applied by a linear actuator (e.g., a hydraulic, pneumatic, or electric actuator). For example, the grippers 146A, 146B may be configured to be brought together to grip part of the tubular received into the recess 139. The grippers 146A, 146B may also include rollers 150, or other friction-reducing members, to facilitate movement of the tubular therethrough, while providing lateral stability.

**[0021]** Considering the power tong 104 in greater detail, Figure 2 illustrates a raised, perspective view of an exterior of the power tong 104, according to an embodiment. The power tong 104 may include a rotatable gripping section 200 and a stationary support section 202. The rotatable section 200 may be annular and may include a central opening or receiving hole 204 therethrough. As will be described in greater detail below, the power tong 104 may include jaws or any other type of engaging structures that extend radially into the receiving hole 204 to grip a tubular received therethrough.

**[0022]** The rotatable section 200 may include a top guard 206, which may be generally disk-shaped and may serve to protect other power tong 104 components from damage, e.g., if an elevator or another object lands on the power tong 104. Further, the rotatable section 200 may include a guide 210, which may be coupled with or disposed within the top guard 206. The guide 210 may be annular and beveled or tapered, so as to receive and direct an end of a tubular therethrough. The guide 210 may be positioned in alignment with the receiving hole 204, and thus may serve to guide the tubular into the receiving hole 204. Further, the guide 210 may be provided in at least two pieces (e.g., segments 210A, 210B), which may be separately removable.

**[0023]** The stationary section 202 may include a device configured to measure a torque on the power tong 104. In an embodiment, such torque-measuring device may be provided in the form of a load cell 216 configured to measure a torque applied thereto. The measured torque may provide information about the torque load applied by the power tong 104 onto a tubular connection, thereby indicating when the connection is fully made up. In an embodiment, the motor 214 may be a hydraulic or electric motor, but in other embodiments, other types of drive systems may be employed.

**[0024]** Figure 3 illustrates a raised perspective view of the power tong 104 with the top guard 206 removed for purposes of illustration, according to an embodiment. As noted above, the top guard 206 may include the cover 208 (Figure 2). The cover 208 covers an access door 400, which may be formed by a gap in the cage plate 211. The rotary ring 215 may extend through the access door 400, but a portion thereof may be removable, e.g.,

along with the door 219, so as to allow lateral entry or exit of a tubular into the receiving hole 204, e.g., to allow removal of the power tong 104 from around the tubular.

**[0025]** Figure 4 illustrates a raised perspective view of the power tong 104 with the top guard 206 and the cage plate 211 removed, for purposes of illustration, according to an embodiment. The power tong 104 may include one or more jaws (three shown: 500A, 500B, 500C), which may be movable to grip a tubular. The jaws 500A-C may thus include teeth, wickers, buttons, grit, high-friction surfaces, or any other structure configured to transmit a high radial and torque load to the tubular. The jaws 500A-C may be coupled with the cage plate 211 (Figure 4), and may be configured to slide radially, between a retracted position and an engaging position, with respect thereto.

**[0026]** The jaws 500A-C are illustrated in the retracted position. In particular, in this embodiment, the rotary ring 215 includes an inner diameter 502 in which one or more pockets (three are shown: 504A, 504B, 504C) are defined, for example, one for each of the jaws 500A-C. The pockets 504A-C may extend radially outward from the inner diameter 502, providing a location into which the jaws 500A-C may be retracted and held away from the tubular received through the receiving hole 204. Thus, the pockets 504A-C may allow the jaws 500A-C to retract, which may allow the power tong 104 to slide over tubular connections, etc. The inner diameter 502 may also include one or more camming surfaces (three shown: 506A, 506B, 506C), which may be arcuate segments that extend radially inwards as proceeding in a circumferential direction around the inner diameter 502 of the rotary ring 215.

**[0027]** In operation, the rotary ring 215 may be driven to rotate relative to the body 212 by the motor 214, which may be hydraulic, electric, etc. The jaws 500A-C may be coupled with the cage plate 211 such that they are non-rotational but radially slidable relative to the cage plate 211. The cage plate 211 may be initially secured against rotation by friction forces applied by the brake band 213. Thus, as the rotary ring 215 begins to rotate relative to the body 212, the rotary ring 215 may also rotate relative to the jaws 500A-C. By such rotation, the jaws 500A-C may be forced out of the pockets 504A-C and radially inward onto the camming surfaces 506A-C. Continued rotation may cause the jaws 500A-C to move farther radially inward until reaching an engaging position, where the jaws 500A-C are designed to engage a tubular received in the receiving hole 204.

**[0028]** When the jaws 500A-C engage a tubular, a force between the jaws 500A-C and the camming surfaces 506A-C may increase, as the camming surfaces 506A-C wedge the jaws 500A-C tighter against the tubular. This may eventually overcome the holding force applied on the cage plate 211 by the brake band 213. Thus, as the rotary ring 215 continues to rotate, the jaws 500A-C and the cage plate 211 may also rotate. Further, this may also cause the tubular engaged by the jaws 500A-C to rotate with respect to the body 212.

**[0029]** When release of the tubular is desired, the rotation of the rotary ring 215 may reverse. Upon reverse rotation of the rotary ring 215, the return springs 510 may hold the jaws 500A-C radially outwards against the camming surface 506A-C and eventually force the jaws 500A-C back into the pockets 504A-C. The pockets 504A-C may thus allow the jaws 500A-C to retract, which may allow the power tong 104 to remain received around a tubular while providing an opening hole 204 sized and configured to allow for passage of a tubular collar. Power tongs of other designs that allow for vertical passage of the tubular and collar through the opening may also be employed with the system 100.

**[0030]** Turning now to the illustrated embodiment of the spider 108, which may fit into the central opening of a rig rotary table or rotary, as mentioned above with respect to Figure 1, Figure 5 illustrates a perspective view of such a spider 108 positioned within the rotary 110, according to an embodiment. The system 100 (Figure 1) also includes a can 700, which may be positioned radially between the spider 108 and the rotary 110. In an embodiment, the can 700 may include a rotary flange 702 that includes two or more flat sides. For example, the rotary flange 702 may be polygonal, e.g., generally octagonal as shown. The rotary 110 may include an inner surface 704 that also includes one or more flat sides, e.g., forming an octagon or another type of polygon. The rotary flange 702 of the can 700 and the inner surface 704 of the rotary 110 may fit together, so as to prevent relative rotation of the can 700 and the rotary 110. In this way, torque may be transmitted between the can 700 and the rotary 110. Further, the spider 108 may be positioned down in the rotary 110, such that top of the spider 108 may extend radially upwards without extending past the top of the rotary 110.

**[0031]** Figure 6 illustrates a perspective view of the spider 108 in the can 700, removed from the rotary 110 (Figure 5), according to an embodiment. The spider 108 may include a guide ring 800. Further, the spider 108 may include a slip-moving mechanism, such as a timing ring 802, to which slips 804 of the spider 108 may be attached. The slips 804 may be pivotally coupled with the timing ring 802, so as to raise and lower therewith. The spider 108 is illustrated with the slips radially-retracted, e.g., by raising the slips 804 out of the inwardly-tapered bowl of the spider 108. As can be seen, the timing ring 802 remains below the rotary flange 702 with the slips 804 raised.

**[0032]** Further, the can 700 includes an open door 806, which may extend along the height of the can 700. The open door 806 may allow for removal of the can 700 (e.g., along with the rest of the system 100), for example, upon completion of run-in, or at any other suitable time. The open door 806, along with the segmented structure of the power tong 104 described above, and the segmented structure of the spider 108, as will be described below, may cooperate to allow system 100 to be removed while the tubular string is supported by an elevator.

**[0033]** Figures 7A and 7B illustrate perspective views of the spider 108 removed from the can 700 and in a retracted position and an engaging position, respectively. The timing ring 802 of the spider 108 may include a control-line gap 803. The control-line gap 803 may be aligned with one or more control-line pockets in the can 700 (Figure 6), e.g., through the bottom of the can 700. The control-line gap 803 may thus be provided to accommodate control/data sensing lines that are affixed to the tubular string and run downhole along with the tubular string.

**[0034]** The spider 108 may further include a body 900, which may be separated into two or more segments 903, 904. The segments 903, 904 may be held together by one or more keyed doors 906, which may, for example, include legs 908 received into grooves 910 formed in the segments 903, 904. The keyed doors 906 may be located 180 degrees apart, for example, around the body 900. As noted above, this segmented structure of the spider 108 may allow for separation and lateral removal of the spider 108 from a tubular received therein (or vice versa). Further, the body 900 may define a conical or tapered bore therein, along which the slips 804 may slide, such that, as the segments 903, 904 move downward relative to the body 900, the slips 804 are pushed radially inwards, e.g., to grip the tubular string.

**[0035]** Further, the body 900 may be coupled with one or more extendable cylinders 912. The extendable cylinders 912 may also be coupled with the timing ring 802 and may be operable to adjust the distance between the body 900 and the timing ring 802. The slips 804, as noted, above, may follow the timing ring 802, and may thus be raised or lowered with respect to the body 900 via the cylinders 912. The cylinders 912 may be hydraulically, pneumatically, mechanically, electro-mechanically, or otherwise actuated. As the slips 804 are lowered into the body 900 (e.g., from Figure 7A to Figure 7B), the slips 804 may move radially inwards and into engagement with a tubular received through the body 900. The slips 804 may have teeth, jaws, wickers, grit, high-friction material, buttons, etc., that may grip the tubular and prevent relative rotation between the slips 804 and the tubular. Further, the cylinders 912 may be sized and configured to cause the slips 804 to apply an initial radial gripping force to the tubular, e.g., during early trip-in while the drill string has a relatively low weight.

**[0036]** The spider 108 may also include one or more control-line guards (e.g., made from an appropriate non-abrasive material). Further, a top guard 914, which may allow for passage of a control line therethrough, may also include a protective layer of a non-abrasive material, e.g., to avoid damaging such a control line.

**[0037]** Figure 8 illustrates another perspective view of the spider 108, showing the bottom thereof, according to an embodiment. The body 900 may include a frustoconical bowl interior shape, as mentioned above. As such, the body 900 may provide a tapered inner surface 902 against which the slips 804 may slide, such that the slips 804 may move radially inwards as they are lowered with

respect to the body 900.

**[0038]** The body 900 may also include two or more lugs (four shown: 950A, 950B, 950C, 950D). The lugs 950A-D may be received into corresponding pockets of the can 700, and may thus transmit torque between the body 900 and the can 700. Furthermore, the lugs 950A-D may be sized smaller than the pockets of the can 700, which may provide a range of motion for the spider 108 within the can 700 and thus with respect to the rotary 110 and the rig floor. In addition, the bottom of the body 900 may be provided with a machined annular space 952 for hydraulic or pneumatic lines used to transfer hydraulic fluid or compressed air (or another gas) to cylinders 912 to extend and retract the cylinders 912.

**[0039]** Figures 9 and 10 illustrate two perspective views of a second tubular handling system 1100 in an expanded configuration, according to an embodiment. The tubular handling system 1100 may include several of the same or similar components as the tubular handling system 100. At least some such similar components are given the same reference numerals in Figures 9-15B as in Figure 1 and duplicative descriptions thereof are omitted herein.

**[0040]** In the embodiment shown, the system 1100 may include a lifting assembly 1102, extending between the can 700 (or the rotary 110, not shown here) and the power tong 104, for lifting the power tong 104. Rather than (or in addition to) a scissor lift, the lifting assembly 1102 may include a "four-bar linkage" type of lifting device. In particular, the lifting assembly 1102 may include a first pair of lifting arms 1106A, 1106B, and a second pair of lifting arms 1108A, 1108B. The arms 1106A,B, 1108A,B, may be pivotably connected to one another, such that an angle formed therebetween may move between, for example, about 0 degrees and about 150 degrees (or more). As the angle increases, the distance between the power tong 104 and the base plate 112 may increase, thereby raising the power tong 104. The lower arms 1106B, 1108B may be pivotably connected to the base plate 112, and the upper arms 1106A, 1108A may be pivotally connected to the power tong 104 and/or to the lifting frame 132.

**[0041]** It will be appreciated that the precise details of the four-bar linkage may be implemented in a variety of ways. For example, a driver 1109 (Figure 10) may be provided for each pair of arms 1106A,B, 1108A,B. Further, the arms 1106A,B, 1108A,B may each include a gear 1114, 1116, 1118, 1119. The driver 1109 may include a rack or another type of mechanical linkage that is capable of engaging the corresponding gears 1114, 1116, 1118, 1119, such that the driver or drivers cause the corresponding gears 1114, 1116, 1118, 1119 to rotate, and thereby pivot the arms 1106A,B, 1108A,B relative to one another.

**[0042]** The lifting assembly 1102 may also include one or more cross-members 1120, which may extend between the pairs of arms 1106A,B, 1108A,B and may be provided to increase a stiffness of the lifting assembly

1102.

**[0043]** Figure 11 illustrates a perspective view of the lifting assembly 1102 in a collapsed configuration, according to an embodiment. As shown, the lifting arms 1106A, 1106B have been pivoted together, such that they extend generally parallel to one another. Further, the arms 134A, 134B of the boxing device 102 may be pivoted towards the base 137. Additionally, the upper frame 136 may be pivoted away from the power tong 104, so as to avoid obstructing access to the center of the power tong 104. The lifting system 100 may have a similar collapsed configuration, as described above.

**[0044]** In this configuration, the boxing device 102, power tong 104, and lifting assembly 1102 are immediately adjacent to one another, providing a reduced vertical profile as compared to the extended position previously discussed. The collapsed configuration may be employed after tubulars are made up together, so as to reduce the obstruction that the system 1100 presents to the vertical range of motion of the tubular handling equipment (e.g., elevators, top drives, etc.), allowing such equipment to be lowered as close as possible to the spider 108 at the rig floor.

**[0045]** Figure 12 illustrates a perspective view of a third tubular handling system 1400, according to an embodiment. In this embodiment, the spider 108 may not be configured to transmit torque ("reactive torque") to a tubular held therein. In such embodiments, a "backup" tong 1402 may be provided for facilitating safe torque transmission. The backup tong 1402 may be positioned near or at the rig floor and positioned above, e.g., immediately above, the spider 108 (located in the can 700 as described above). The backup tong 1402 may be connected to the lifting assembly 1102, such that torque is transmitted through the power tong 104, the lifting assembly 1102, and the backup tong 1402 to a tubular engaged by the backup tong 1402.

**[0046]** In a specific embodiment, the backup tong 1402 may include gripping members 1404, 1406, which may be movable toward and away from each other via one or more actuators 1408, 1410. The actuators 1408, 1410 may be hydraulic actuators. Further, the gripping members 1404, 1406 may have teeth, wickers, buttons, grit, high-friction material, etc. on an inner radial surface thereof, which may be configured to bite into or otherwise engage a tubular received through the power tong 104 and the spider 108. The backup tong 1402 may thus be configured to transmit torque applied to the lifting assembly 1102 by the action of the power tong 104 and safely transmit the torque to the rig floor.

**[0047]** Figure 13 illustrates a perspective view of a fourth tubular handling system 1600, according to an embodiment. Figure 14 illustrates a side view of the fourth tubular handling system 1600, according to an embodiment. Referring to Figures 13 and 14, the tubular handling system 1600 may include a backup tong 1602, which may be elevated from the spider 108 in the can 700, at least when the tubular handling system 1600 is in the

illustrated extended position. For example, the backup tong 1602 may be elevated along with the power tong 104, by movement of the lifting assembly 1102, during operation. The backup tong 1602 may serve a similar purpose as the aforementioned backup tong. In addition, the placement and configuration of the backup tong 1602 may prevent all or some torque from being transferred through the lifting assembly 1102, such that torque is transferred directly from the power tong 104 to the backup tong 1602 and to the tubular engaged thereby.

**[0048]** Generally, the backup tong 1602 may be positioned sufficiently vertically below the power tong 104 that the power tong 104 may be positionable to engage one tubular, while the backup tong 1602 may be configured to engage another tubular. For example, the backup tong 1602 may engage the stump held in the spider 108, while the power tong 104 engages a new, add-on tubular to be made up to the stump.

**[0049]** In a specific embodiment, the backup tong 1602 may include a torque-reaction frame 1604, which may be connected to the power tong 104, the lifting frame 132, or both. Further, the backup tong 1602 may be suspended from the power tong 104, the lifting frame 132, or both by any number of supporting members, such as cables 1608, 1610. The cables 1608, 1610 may permit the lifting assembly to collapse until the power tong 104 approaches the top of the backup tong 1602.

**[0050]** The system 1600 may also include a torque-reaction post 1606 and a torque-reaction mechanism 1620, which cooperate with the torque-reaction frame 1604 to receive and measure torque applied to the tubular connection being made up. Accordingly, in this embodiment, the torque-measuring device may be provided in the form of the torque-reaction mechanism 1620.

**[0051]** Figure 15A illustrates a perspective view of another tubular handling system 1800, according to an embodiment. Figure 15B illustrates a side view of the tubular handling system 1800, according to an embodiment. As shown, the tubular handling system 1800 may include a backup tong 1802 that may be similar in structure and function to the backup tong 1602, but may be held in an elevated position with respect to the spider 108 (which is disposed within the illustrated can 700, as explained above), at least when the tubular handling system 1800 is in an extended position, as shown. For example, the backup tong 1802 may be elevated along with the power tong 104, by movement of the lifting assembly 1102, during operation. In particular, in an embodiment, the backup tong 1802 may include a frame 1804, which may be connected to the power tong 104, the lifting frame 132, or both. Further, the backup tong 1802 may be suspended from the power tong 104, the lifting frame 132, the base 137, or a combination thereof by any number of supporting members, such as cables 1806, 1808.

**[0052]** An example of the operation of one or more embodiments of the tubular handling systems 100, 1100, 1400, 1600, and 1800 will now be described. In particular, Figure 16 illustrates a flowchart of an embodiment of a

method 1900 for such tubular handling operation, which will be described with reference to Figures 17A-17F, showing stages of the operation/method. Further, the tubular handling system 1100 is used for illustrative purposes in these figures, but it will be readily apparent that the method 1900 may be employed and/or tailored for use with any of the tubular handling assemblies discussed above and/or others.

**[0053]** The method 1900 may begin by supporting a tubular string 2002 using a spider 108 near the rig floor 2000, as at 1902. This is illustrated in Figure 17A. The tubular string 2002 may include one or more joints of tubulars, such as casing, which may extend into a well. The spider 108 may or may not be able to transmit torque to the tubular string 2002, as described above. At this stage, the tubular handling system 1100 may be in its collapsed configuration, as shown. For example, the arms 1106A, 1106B are positioned such that they are generally parallel to one another, providing a low vertical profile for the lifting assembly 1102. This may result in the power tong 104 being relatively close to the spider 108 (in the can 700). Further, the boxing device 102 is in a retracted position, and the upper frame 136 pivoted away from the power tong 104 and a tubular string 2002 received through the power tong 104 and the spider 108. The spider 108 may support the vertical load (weight) of the tubular string 2002 and any structures (tubulars, tools, etc.) coupled thereto as part of a tubular string. In this position, a portion of the tubular string 2002 extends upwards from the power tong 104, and may terminate with an upper connection 2004. The upper connection 2004 may be a "threaded box" end of the tubular string 2002, configured to receive and couple to a threaded pin end of another tubular, in a process generally referred to as "make-up".

**[0054]** When it becomes desirable to add a new tubular to an upper connection 2004 of the tubular string 2002, the method 1900 may proceed to extending the tubular handling system 1100 to an intermediate position, as at 1904. This is shown in Figure 17B. For example, as shown, the lifting assembly 1102 may be partially expanded to a configuration between fully-expanded and fully-collapsed. In this intermediate position, the power tong 104 may be around the tubular string 2002, below the upper connection 2004. Further, the boxing device 102 may be actuated to a pipe-receiving position, as at 1906, as shown, with the upper frame 136 pivoted to catch an add-on tubular 2100, as at 1908. In some embodiments, the grippers 146A, 146B (see, e.g., Figure 1) may be actuated to complete the catching of the add-on tubular 2100 in the recess 139 of the frame 136.

**[0055]** Referring now to Figure 17C, the boxing device 102 may be employed to facilitate centering the add-on tubular 2100 above well center, as at 1910. In an embodiment, the arms 134A, 134B of the boxing device 102 may be pivoted into an intermediate position, between fully-collapsed and fully-expanded, which may result in a lower connection 2200 of the add-on tubular 2100 being

above and generally (e.g., within an acceptable tolerance of) coaxial with the upper connection 2004 of the tubular string 2002.

**[0056]** Next, as at 1912 and shown in Figure 17D, the add-on tubular 2100 may be lowered toward the tubular string 2002 held by the spider 108, such that the lower connection 2200 of the add-on tubular 2100 engages or is positioned closely proximal to the upper connection 2004 of the tubular string 2002. For example, in this position, rotation of the add-on tubular 2100 relative to the tubular string 2002 may cause threads of the upper and lower connections 2004, 2200 to engage and thereby connect the tubular string 2002 and the add-on tubular 2100.

**[0057]** Further, as at 1914, the lifting assembly 1102 may be extended upward (e.g., away from the rig floor 2000) to an extended position, which may or may not be the full extent of the range of motion of the lifting assembly 1102, depending on the configuration. As the lifting assembly 1102 is moved, the power tong 104 may slide axially past the upper connection 2004, without the power tong 104 being laterally removed from the tubular string 2002. Eventually, as shown, the power tong 104 becomes positioned around the tubular 2100, e.g. above the threaded region of the lower connection 2200.

**[0058]** The power tong 104 may then engage the add-on tubular 2100, as described above, as at 1916, and apply torque thereto, to rotate the add-on tubular 2100, as at 1918. The reactionary torque in the power tong 104 may be transmitted to the tubular string 2002 via the lifting assembly 1102 and the spider 108, in one embodiment. In some embodiments, a backup tong (as described above) may engage the tubular string 2002, as indicated at 1917, and may be employed in addition to or instead of a spider 108 to transmit such torque to the tubular string 2002.

**[0059]** Rotation of the add-on tubular 2100 may proceed by rotating the rotatable section 200 of the power tong 104 until the jaws 500A-C (Figure 4) thereof engage the add-on tubular 2100. The rotation of the power tong 104 may continue until a predetermined amount of torque is applied to the add-on tubular 2100, indicating connection is complete. Further, the engagement between the jaws 500A-C and the tubular 2100 may thus serve to center the power tong 104 on the add-on tubular 2100 and thus on the well.

**[0060]** As the power tong 104 applies torque to the add-on tubular 2100, the add-on tubular 2100 rotates relative to the tubular string 2002, resulting in engagement therebetween, as noted above. Further, such rotation and engagement results in the add-on tubular 2100 moving downwards as the threads of the upper connection 2200 are progressively received into the lower connection 2004. The lifting assembly 1102 may thus collapse slightly, moving the power tong 104 downwards, during the connection process, as at 1920. This is referred to as "thread compensation."

**[0061]** Referring to Figure 17E, as shown, the add-on



tubular 2100 has been fully connected to the tubular string 2002. At some point during the connection process, as at 1922, the boxing device 102 may be collapsed and the frame 136 pivoted away from the add-on tubular 2100. This may take place before, during, or after the power tong 104 rotates the add-on tubular 2100. In this configuration, with the add-on tubular 2100 fully connected to the tubular string 2002, an elevator may engage the add-on tubular 2100, and support the tubular string 2002 via connection with the add-on tubular 2100. Thus, the power tong 104 (and backup tong, if provided) and the spider 108 may release the add-on tubular 2100 and the tubular string 2002, respectively, as at 1924.

**[0062]** As shown in Figure 17F, the tubular handling system 1100 may be collapsed, as at 1926. In some embodiments, this may occur after the power tong 104 releases from engagement with the add-on tubular 2100. In other embodiments, the tubular handling system 1100 may be collapsed as the add-on tubular 2100 is lowered through the spider 108, as at 1928. Once the elevator 2300 reaches the lower range of its movement, e.g., adjacent to, in contact, or spaced apart from the power tong 104, the spider 108 may engage the tubular 2100, the elevator 2300 may release the add-on tubular 2100, and the elevator 2300 may be moved upward (e.g., away from the add-on tubular 2100 and/or rig floor 2000). The next add-on tubular may then be loaded into position using the process and equipment discussed above.

**[0063]** While the present teachings have been illustrated with respect to one or more implementations, alterations and/or modifications may be made to the illustrated examples without departing from the spirit and scope of the appended claims. In addition, while a particular feature of the present teachings may have been disclosed with respect to only one of several implementations, such feature may be combined with one or more other features of the other implementations as may be desired and advantageous for any given or particular function. Furthermore, to the extent that the terms "including," "includes," "having," "has," "with," or variants thereof are used in the detailed description and the claims, such terms are intended to be inclusive in a manner similar to the term "comprising." Further, in the discussion and claims herein, the term "about" indicates that the value listed may be somewhat altered, as long as the alteration does not result in nonconformance of the process or structure to the illustrated embodiment. Finally, "exemplary" indicates the description is used as an example, rather than implying that it is an ideal.

**[0064]** Other embodiments of the present teachings will be apparent to those skilled in the art from consideration of the specification and practice of the present teachings disclosed herein. It is intended that the specification and examples be considered as exemplary only, with a true scope and spirit of the present teachings being indicated by the following claims.

**[0065]** The following numbered statements form part of the present disclosure:

Statement 1. A tubular handling system, comprising:

a power tong configured to engage and rotate an add-on tubular by applying a torque thereto, the power tong defining a central opening configured to receive the add-on tubular there-through;  
a spider disposed at a rig floor, the spider being configured to support a tubular string;  
a lifting assembly coupled with the power tong and configured to move the power tong vertically with respect to the tubular string and the spider; and  
a torque-measuring device configured to measure a reactionary torque transmitted from the power tong to the lifting assembly.

Statement 2. The tubular handling system of statement 1, further comprising a boxing device coupled with the lifting assembly and movable vertically along with the power tong, the boxing device being pivotable with respect to the power tong and configured to align the tubular with respect to the power tong.

Statement 3. The tubular handling system of statement 2, wherein the boxing device comprises:

one or more legs that are pivotal with respect to the power tong;  
a frame coupled to the one or more legs, such that pivoting of the one or more legs adjusts a vertical distance between the frame and the power tong; and  
one or more grippers coupled to the frame, the one or more grippers being movable with respect to the add-on tubular, to engage the add-on tubular.

Statement 4. The tubular handling system of statement 1, further comprising a can disposed between the spider and a rotary, wherein the can is configured to transmit torque to the spider.

Statement 5. The tubular handling system of statement 4, wherein a top of the spider is vertically lower than a top of the rotary, such that a slip moving mechanism of the spider is movable to disengage slips of the spider without extending above the top of the rotary.

Statement 6. The tubular handling system of statement 1, wherein the lifting assembly comprises a plurality of arms that are pivotable to move the power tong vertically.

Statement 7. The tubular handling system of statement 6, wherein the lifting assembly comprises a scissor jack arrangement or a four-bar linkage ar-

rangement.

Statement 8. The tubular handling system of statement 1, wherein the power tong comprises a plurality of engaging members, the plurality of engaging members being configured to move between an engaging position and a retracted position, the plurality of engaging members in the engaging position being configured to apply a torque to the tubular, and the plurality of engaging members in the retracted position being spaced radially apart from the tubular such that the power tong is vertically movable over a box-end connection of the tubular string.

Statement 9. The tubular handling system of statement 1, wherein the spider is configured to transmit a reactionary torque to the tubular string, when supporting the tubular string, the reactionary torque being generated in reaction to torque applied by the power tong.

Statement 10. The tubular handling system of statement 9, wherein the lifting assembly transmits the reactionary torque from the power tong to the spider.

Statement 11. The tubular handling system of statement 1, further comprising a backup tong, the backup tong being configured to engage the tubular string and transmit a reactionary torque to the tubular string, the reactionary torque being generated in reaction to the torque applied by the power tong.

Statement 12. The tubular handling system of statement 11, wherein the backup tong is coupled to the lifting assembly and configured to receive the reactionary torque from the power tong via the lifting assembly.

Statement 13. The tubular handling system of statement 11, wherein the backup tong is coupled to the power tong and configured to receive the reactionary torque directly therefrom.

Statement 14. The tubular handling system of statement 11, wherein the backup tong is positioned vertically below the power tong such that a connection between the add-on tubular and the tubular string is positionable vertically between the backup tong and the power tong.

Statement 15. A method for handling tubulars, comprising:

supporting a tubular string using a spider of a tubular handling system, wherein a power tong of the tubular handling system is disposed around the tubular string, the tubular handling system further comprising a lifting assembly in

a collapsed configuration;  
moving the power tong upwards along the tubular string, past an upper connection thereof, and around an add-on tubular to be connected to the tubular string, by expanding the lifting assembly and without laterally moving the power tong from around the tubular string;  
rotating the add-on tubular using the power tong, to connect a lower connection of the add-on tubular to the upper connection of the tubular string, such that the add-on tubular becomes part of the tubular string;  
disengaging the power tong from the add-on tubular;  
lowering the power tong past the lower connection of the add-on tubular and the upper connection of the tubular string by collapsing the lifting assembly, without laterally moving the power tong from around the tubular string, such that the power tong is positioned proximal to the spider;  
disengaging the spider from the tubular string; and  
lowering the tubular string, including the add-on tubular, through the spider and the power tong.

Statement 16. The method of statement 15, further comprising:

expanding a boxing device coupled to the power tong, such that a frame of the boxing device is moved away from the power tong;  
catching the add-on tubular using the frame; and  
positioning the add-on tubular over the tubular string using the boxing device, before moving the power tong upwards along the tubular string, past the upper connection thereof, and around the add-on tubular.

Statement 17. The method of statement 16, wherein:

catching the add-on tubular comprises receiving the add-on tubular in a recess formed in the frame, and gripping the add-on tubular using gripping members of the boxing device;  
positioning the add-on tubular comprises pivoting one or more legs of the boxing device with respect to the power tong, such that the add-on tubular is generally coaxial with the tubular string; and  
the method further comprises lowering the add-on tubular after positioning the add-on tubular such that the add-on tubular engages the tubular string.

Statement 18. The method of statement 16, further comprising moving the power tong upwards by expanding the lifting assembly, such that the power

tong is below the upper connection, after positioning the add-on tubular over the tubular string using the boxing device, and before moving the power tong up around the add-on tubular.

Statement 19. The method of statement 15, further comprising engaging the tubular string using a back-up tong, such that the backup tong transmits a reactionary torque of the power tong to the tubular string.

Statement 20. The method of statement 15, further comprising engaging the tubular string using the power tong prior to moving the power tong past the upper connection of the tubular string, to center the power tong on the tubular string.

Statement 21. The method of statement 15, further comprising engaging the tubular string using the power tong to center the power tong on the tubular string.

Statement 22. The method of statement 15, wherein:

rotating the add-on tubular using the power tong comprises rotating a rotatable section of the power tong in a first direction such that engaging members of the power tong extend radially inwards; and

disengaging the add-on tubular from the power tong comprises rotating the rotatable section of the power tong in a second direction such that engaging members retract, the first and second directions being opposite to one another.

Statement 23. The method of statement 15, further comprising lowering the power tong by partially collapsing the lifting assembly, while rotating the add-on tubular to connect the upper and lower connections, for thread compensation.

## Claims

1. A tubular handling system (100), comprising:

a power tong (104) configured to engage and rotate an add-on tubular (2100) by applying a torque thereto, the power tong (104) defining a central opening (204) configured to receive the add-on tubular (2100) therethrough;

a spider (108) disposed at a rig floor, the spider (108) being configured to support a tubular string (2002);

a back-up tong (1402) configured to engage the tubular string (2002) above the spider (108) and transmit a reactionary torque to the tubular string (2002), the reactionary torque being generated in reaction to the torque applied by the power

tong (104); and  
a lifting assembly (106) coupled to the power tong (104) and configured to move the power tong (104) and the back-up tong (1402) vertically with respect to the tubular string (2002) and the spider (108).

2. The tubular handling system (100) of claim 1, further comprising a torque-measuring device configured to measure the reactionary torque transmitted from the power tong (104) to the back-up tong (1402).

3. The tubular handling system (100) of claim 1 or 2, wherein the lifting assembly (106) comprises a scissor jack arrangement or a four-bar linkage arrangement, and a base plate (112) centered on a wellbore.

4. The tubular handling system (100) of any of the preceding claims, wherein the back-up tong (1402) is coupled to the lifting assembly (106) and is configured to receive the reactionary torque from the power tong (104) via the lifting assembly (106).

5. The tubular handling system (100) of any of claims 1 to 3, wherein the back-up tong (1402) is coupled to the power tong (104) and configured to receive the reactionary torque directly therefrom.

6. The tubular handling system (100) of claim 5, wherein the back-up tong (1402) is positioned vertically below the power tong (104) such that a connection between the add-on tubular (2100) and the tubular string (2002) is positionable vertically between the back-up tong (1402) and the power tong (104).

7. The tubular handling system (100) of any of the preceding claims, further comprising a boxing device (102) coupled with the lifting assembly (106) and movable vertically along with the power tong (104), the boxing device (102) being pivotable with respect to the power tong (104) and configured to align the tubular with respect to the power tong (104).

8. The tubular handling system (100) of claim 7, wherein the boxing device (102) comprises:

one or more arms (134A, 134B) that are pivotable with respect to the power tong (104);

a lifting frame (132) coupled to the one or more arms (134A, 134B), such that pivoting of the one or more arms (134A, 134B) adjusts a vertical distance between the lifting frame (132) and the power tong (104); and

one or more grippers (146A, 146B) coupled to the lifting frame (132), the one or more grippers (146A, 146B) being movable with respect to the add-on tubular (2100), to engage the add-on tubular (2100).

**9.** A method for handling tubulars, comprising:

supporting a tubular string (2002) using a spider (108) of a tubular handling system (100), the spider (108) being disposed at a rig floor (2000);  
 moving a power tong (104) upwards along the tubular string (2002), past an upper connection (2004) thereof, and around an add-on tubular (2100) to be connected to the tubular string (2002), by expanding a lifting assembly (106) and without laterally moving the power tong (104) from around the tubular string (2002);  
 engaging the tubular string (2002) using a back-up tong (1402);  
 engaging the add-on tubular (2100) using the power tong (104);  
 rotating the add-on tubular (2100) relative to the tubular string (2002) using the power tong (104), so as to connect a lower connection (2200) of the add-on tubular (2100) to the upper connection (2004) of the tubular string (2002), such that the add-on tubular (2100) becomes part of the tubular string (2002), wherein the back-up tong (1402) transmits a reactionary torque generated by the power tong (104) to the tubular string (2002);  
 disengaging the power tong (104) from the add-on tubular (2100);  
 disengaging the back-up tong (1402) from the tubular string (2002);  
 lowering the power tong (104) past the lower connection (2200) of the add-on tubular (2100) and the upper connection (2004) of the tubular string (2002) by collapsing the lifting assembly (106), without laterally moving the power tong (104) from around the tubular string (2002), such that the power tong (104) is positioned proximal to the spider (108); and  
 lowering the tubular string (2002), including the add-on tubular (2100), through the power tong (104).

**10.** The method of claim 9, wherein the lifting assembly (106) is coupled to the back-up tong (1402), such that the lifting assembly (106) transmits the reactionary torque from the power tong (104) to the back-up tong (1402).

**11.** The method of claim 9, wherein the back-up tong (1402) is connected to the power tong (104), such that the reactionary torque is transmitted directly from the power tong (104) to the back-up tong (1402).

**12.** The method of any of claims 9 to 11, further comprising:

expanding a boxing device (102) coupled to the power tong (104), such that an upper frame

(136) of the boxing device (102) is moved away from the power tong (104);  
 catching the add-on tubular (2100) using the upper frame (136); and  
 positioning the add-on tubular (2100) over the tubular string (2002) using the boxing device (102), before moving the power tong (104) upwards along the tubular string (2002), past the upper connection (2004) thereof, and around the add-on tubular (2100).

**13.** The method of claim 12, wherein:

catching the add-on tubular (2100) comprises receiving the add-on tubular (2100) in a recess (139) formed in the upper frame (136), and gripping the add-on tubular (2100) using grippers (146A, 146B) of the boxing device (102);  
 positioning the add-on tubular (2100) comprises pivoting one or more arms (134A, 134B) of the boxing device (102) with respect to the power tong (104), such that the add-on tubular (2100) is generally coaxial with the tubular string (2002); and  
 the method further comprises lowering the add-on tubular (2100) after positioning the add-on tubular (2100) such that the add-on tubular (2100) engages the tubular string (2002).

**14.** The method of claim 13, further comprising moving the power tong (104) upwards by expanding the lifting assembly (106), such that the power tong (104) is below the upper connection (2004), after positioning the add-on tubular (2100) over the tubular string (2002) using the boxing device (102), and before moving the power tong (104) up around the add-on tubular (2100).

**15.** The method of any of claims 9 to 14, further comprising engaging the tubular string (2002) using the power tong (104) prior to moving the power tong (104) past the upper connection (2004) of the tubular string (2002), to center the power tong (104) on the tubular string (2002).

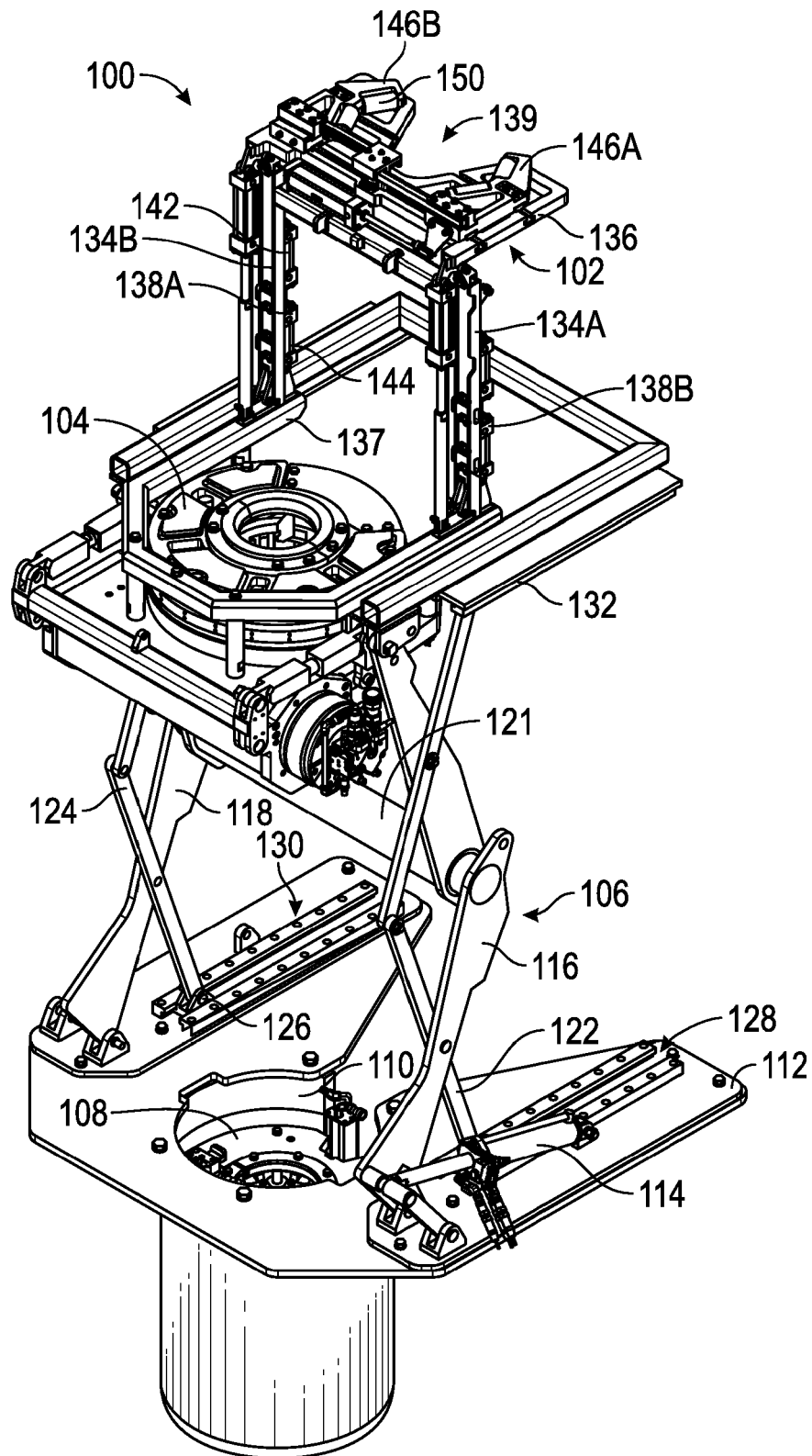


FIG. 1

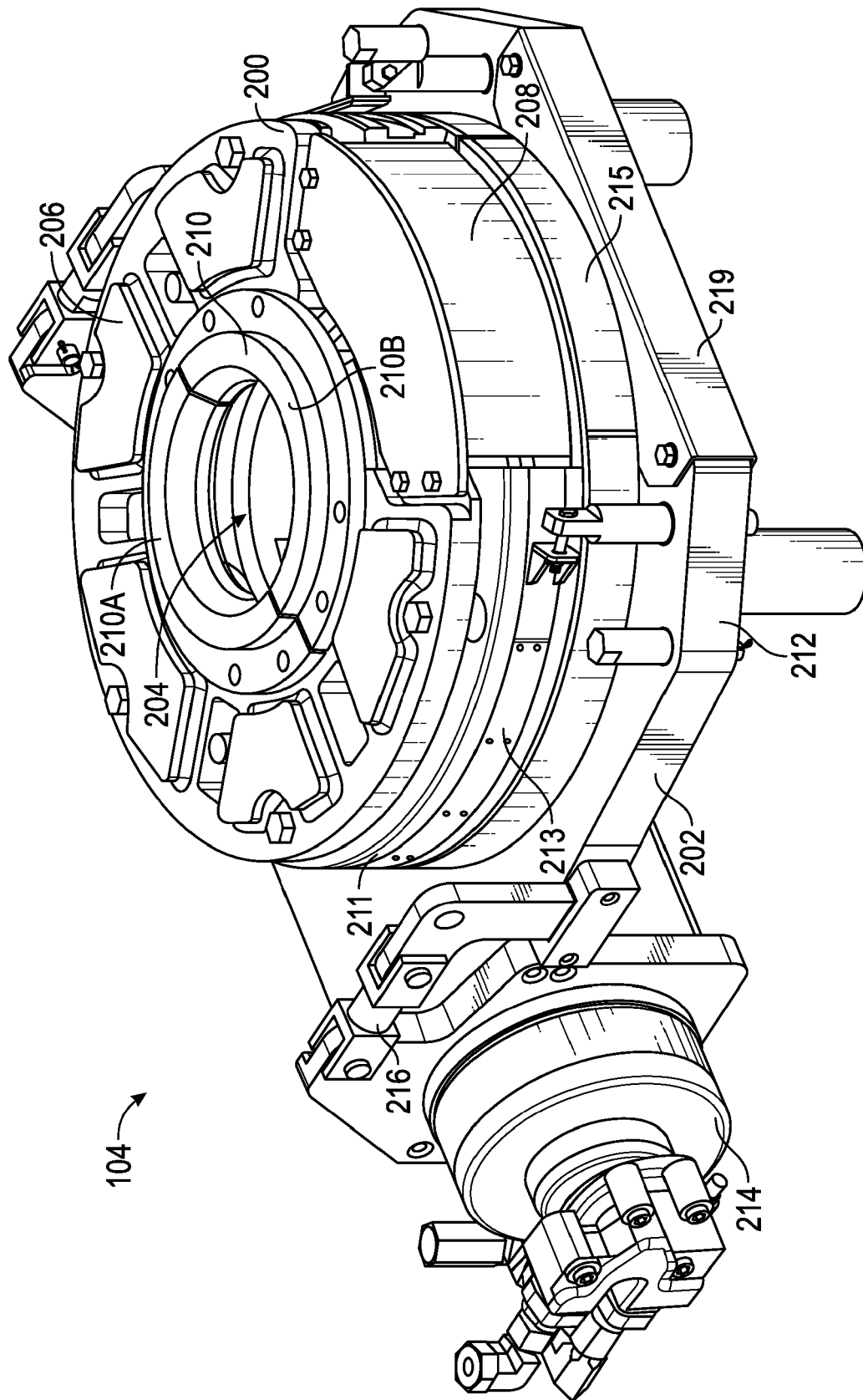


FIG. 2

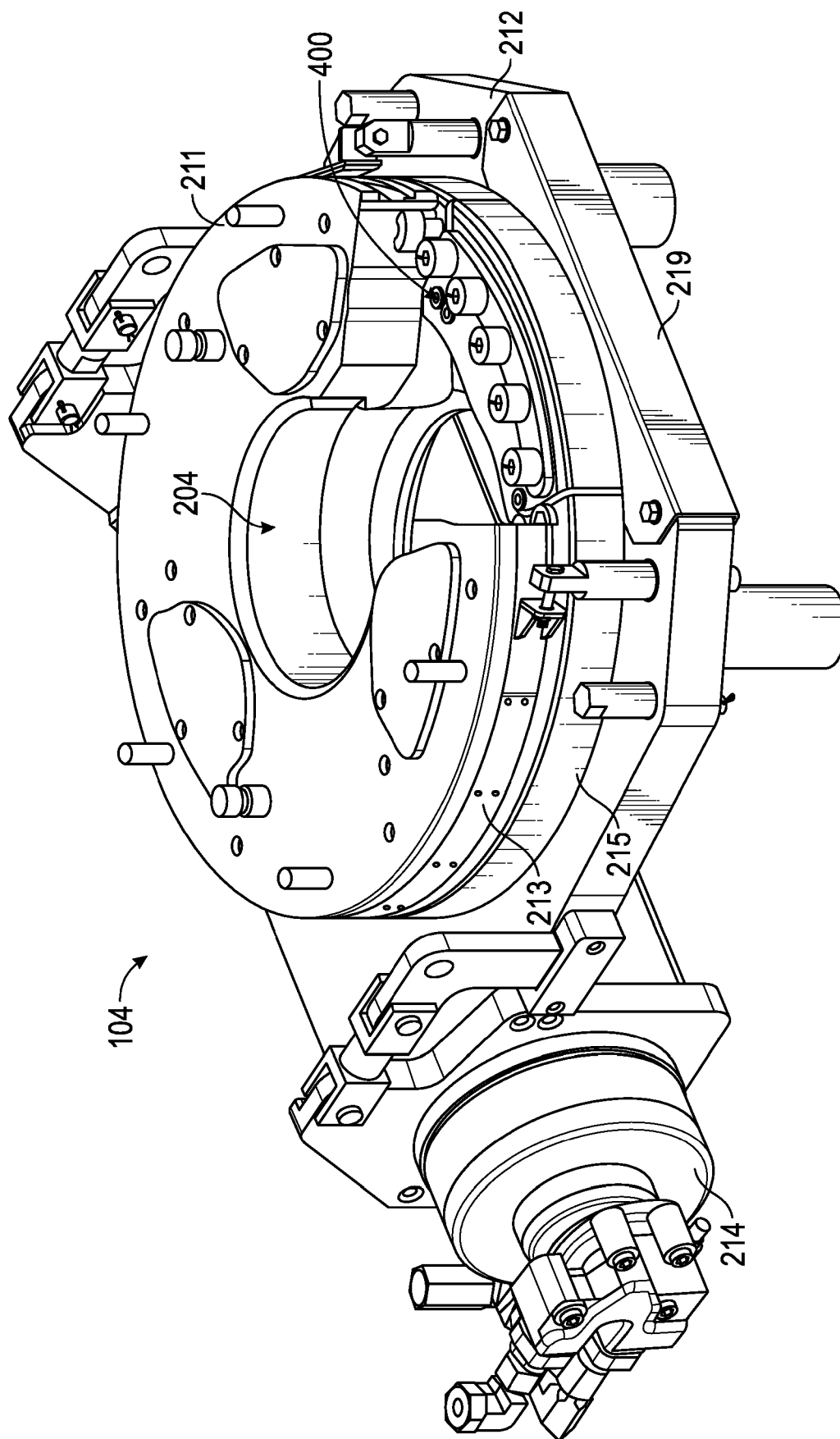


FIG. 3

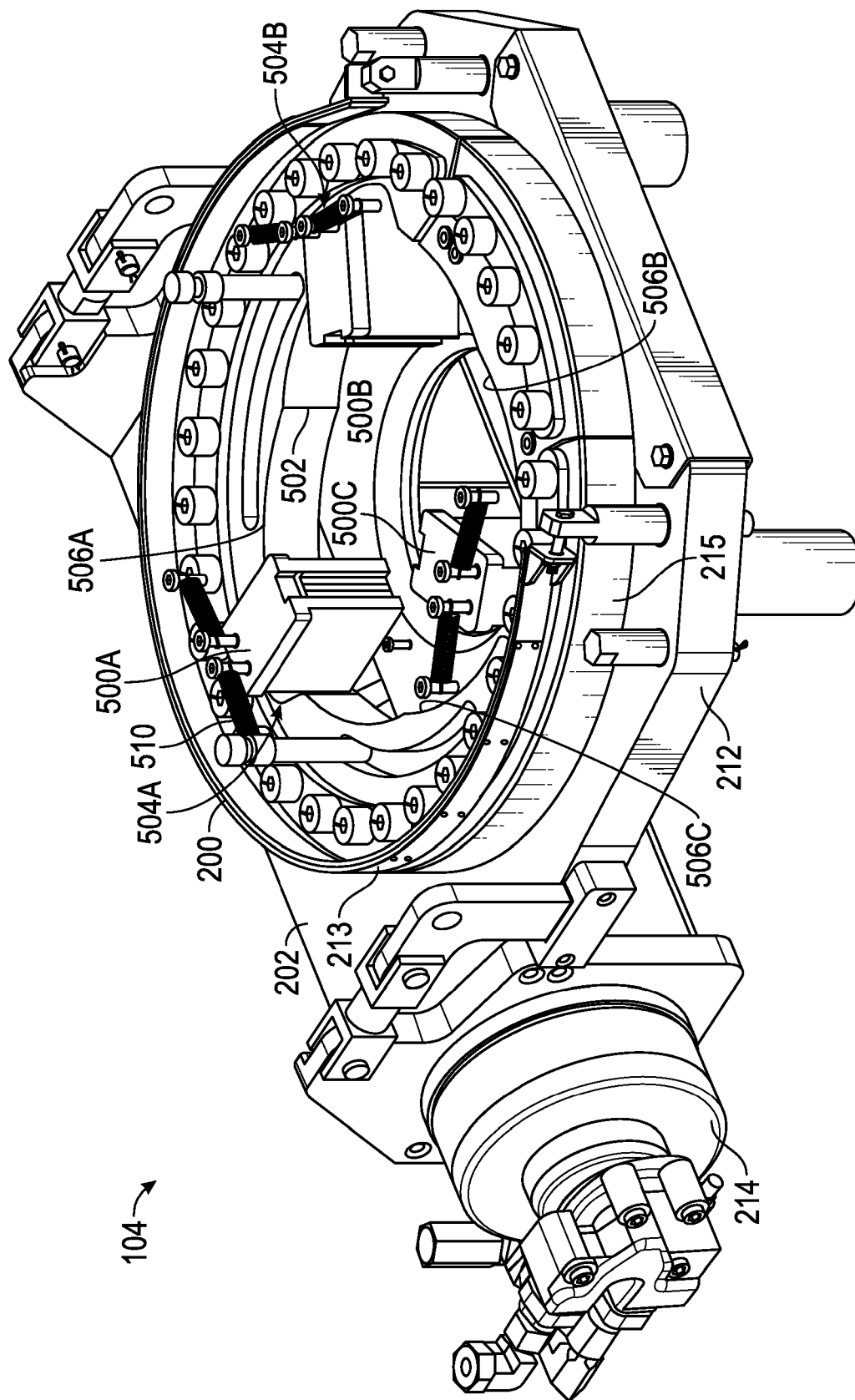


FIG. 4



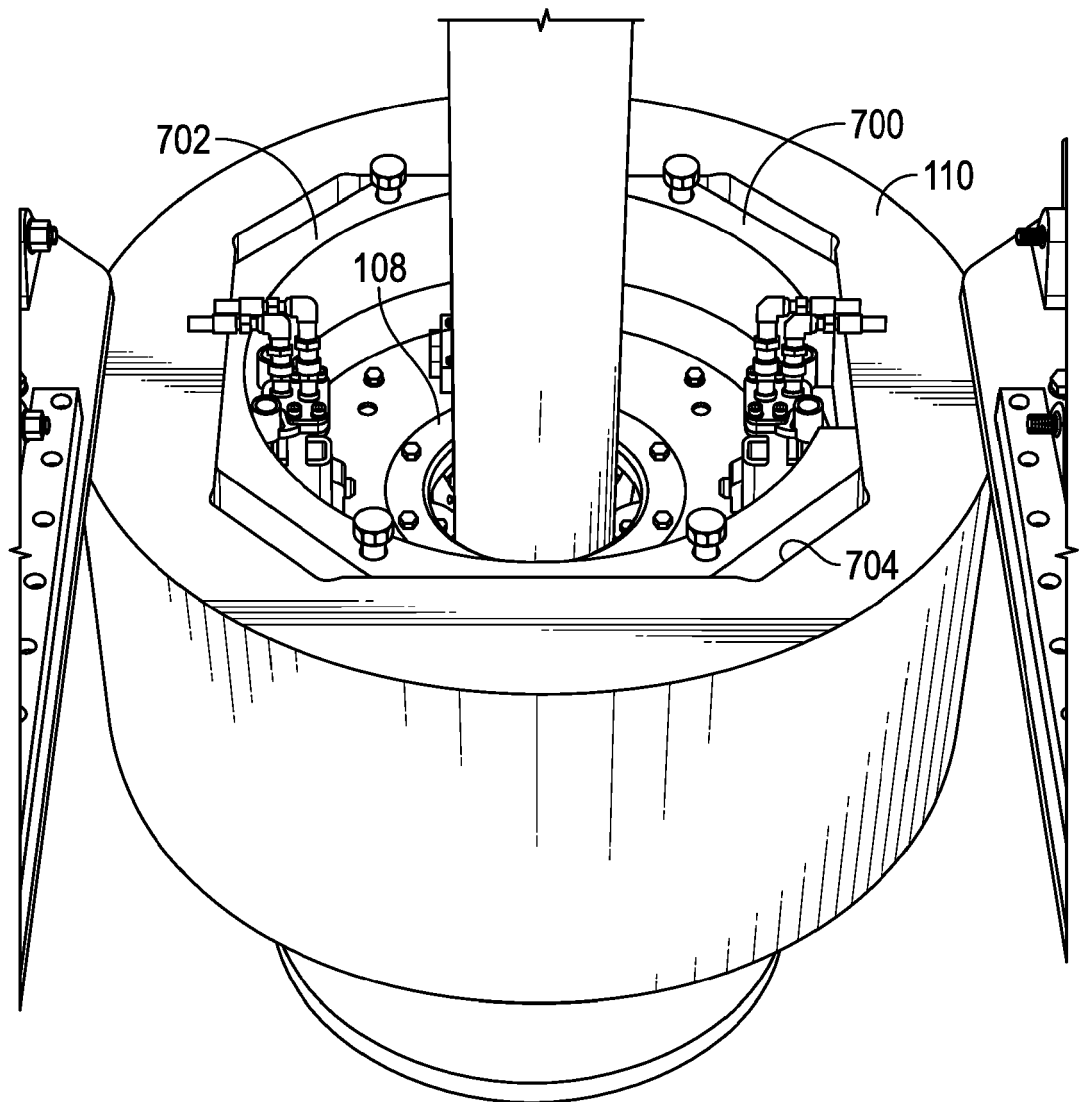


FIG. 5

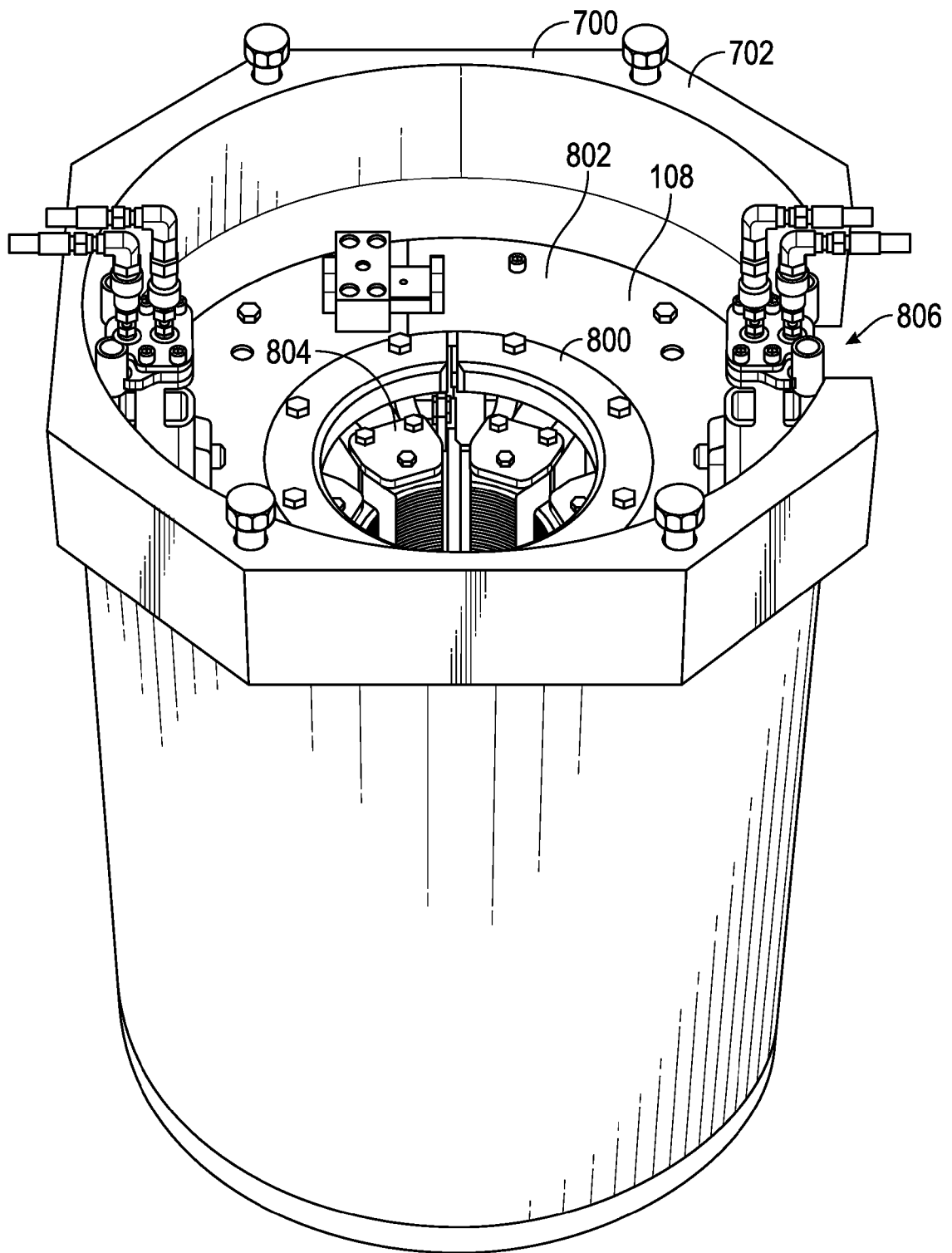


FIG. 6

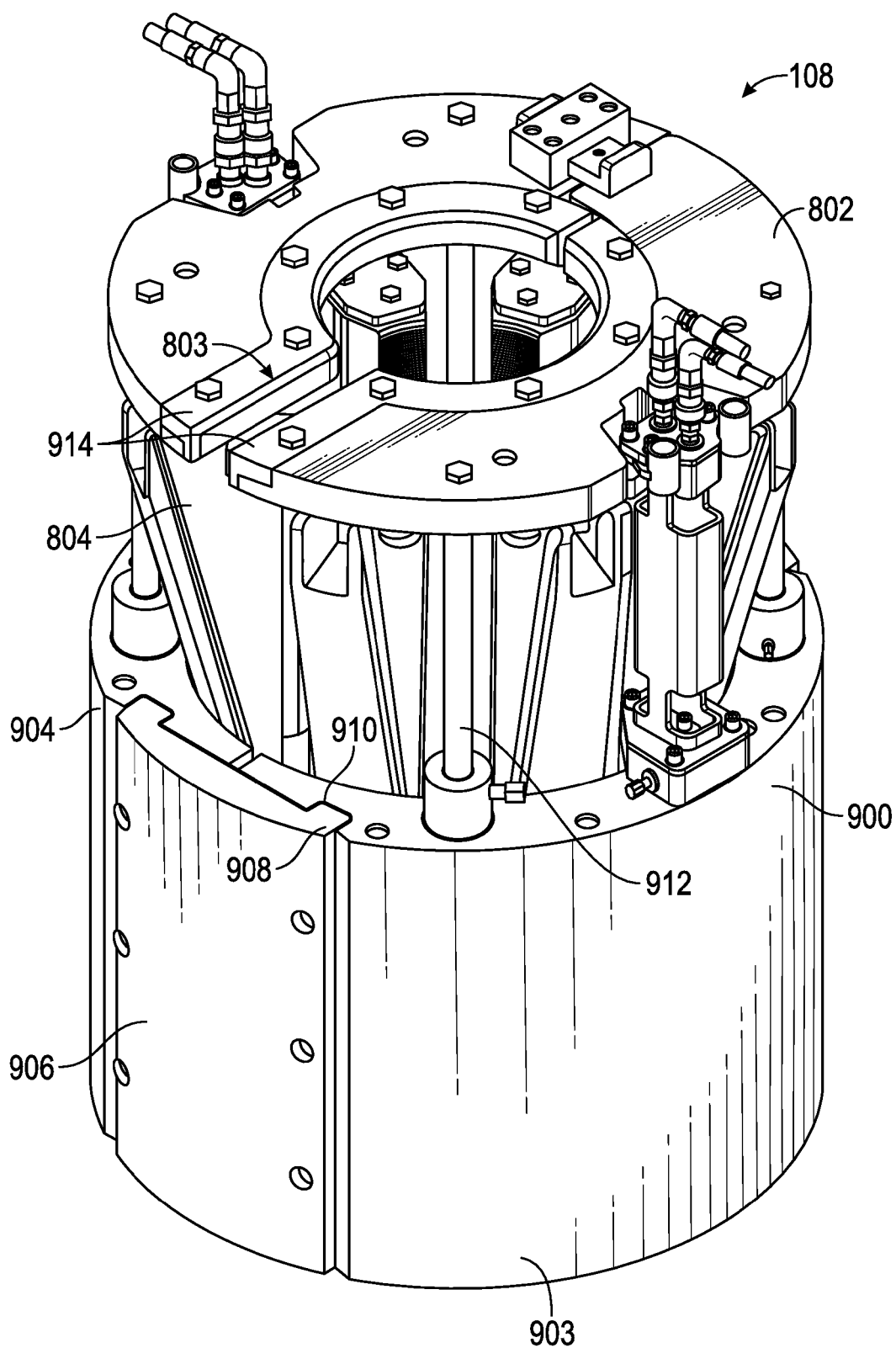


FIG. 7A

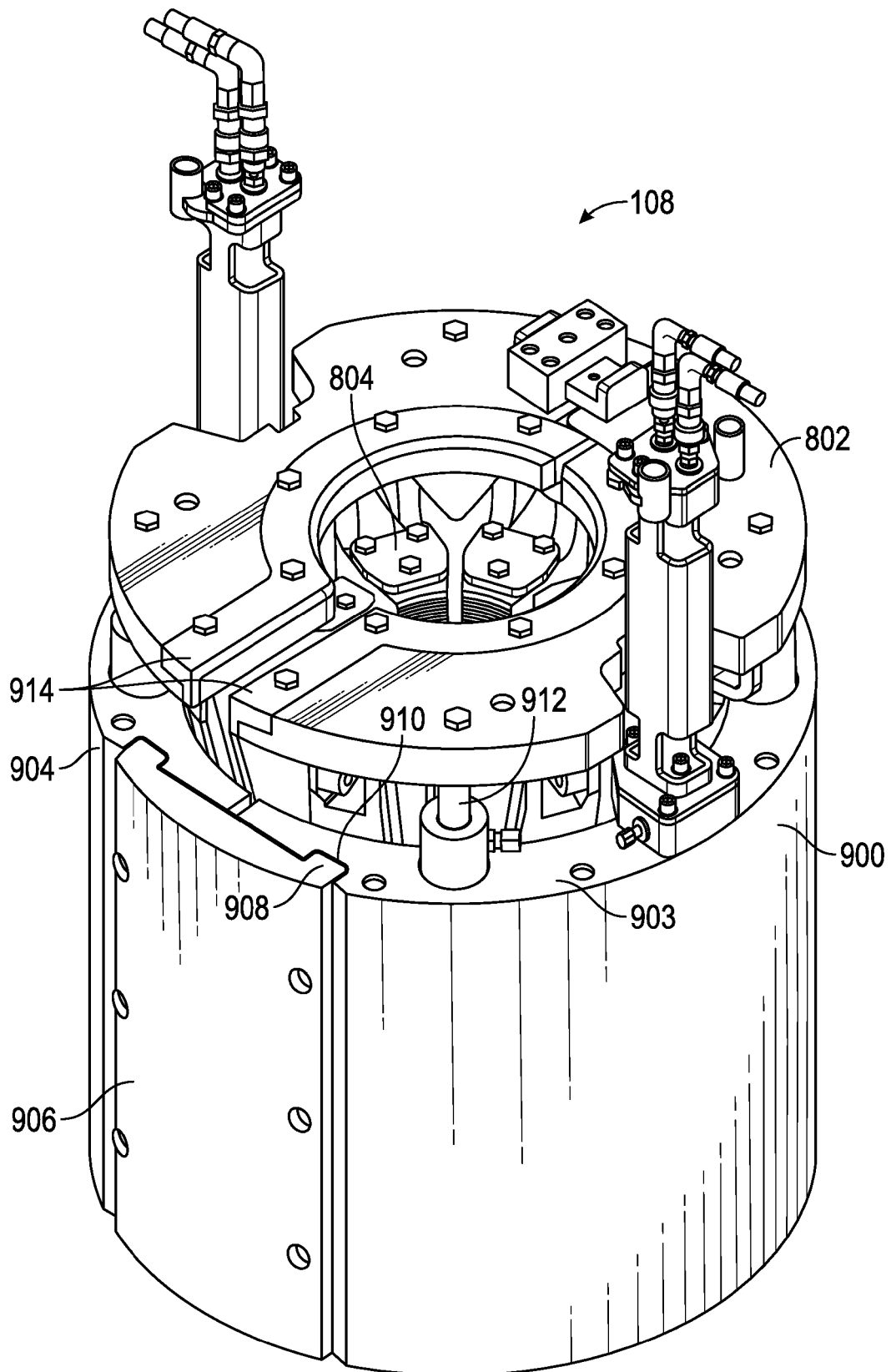


FIG. 7B

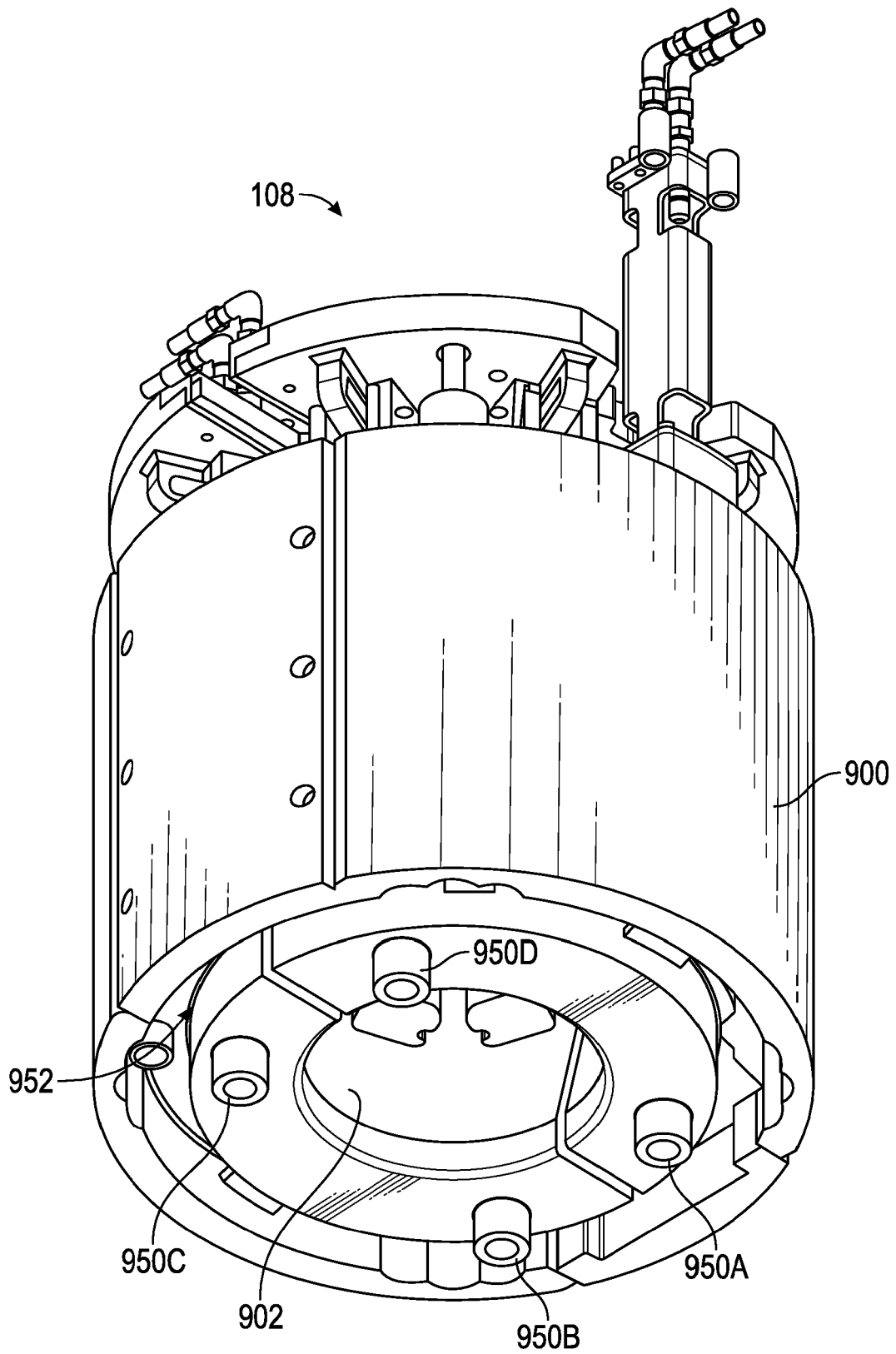


FIG. 8

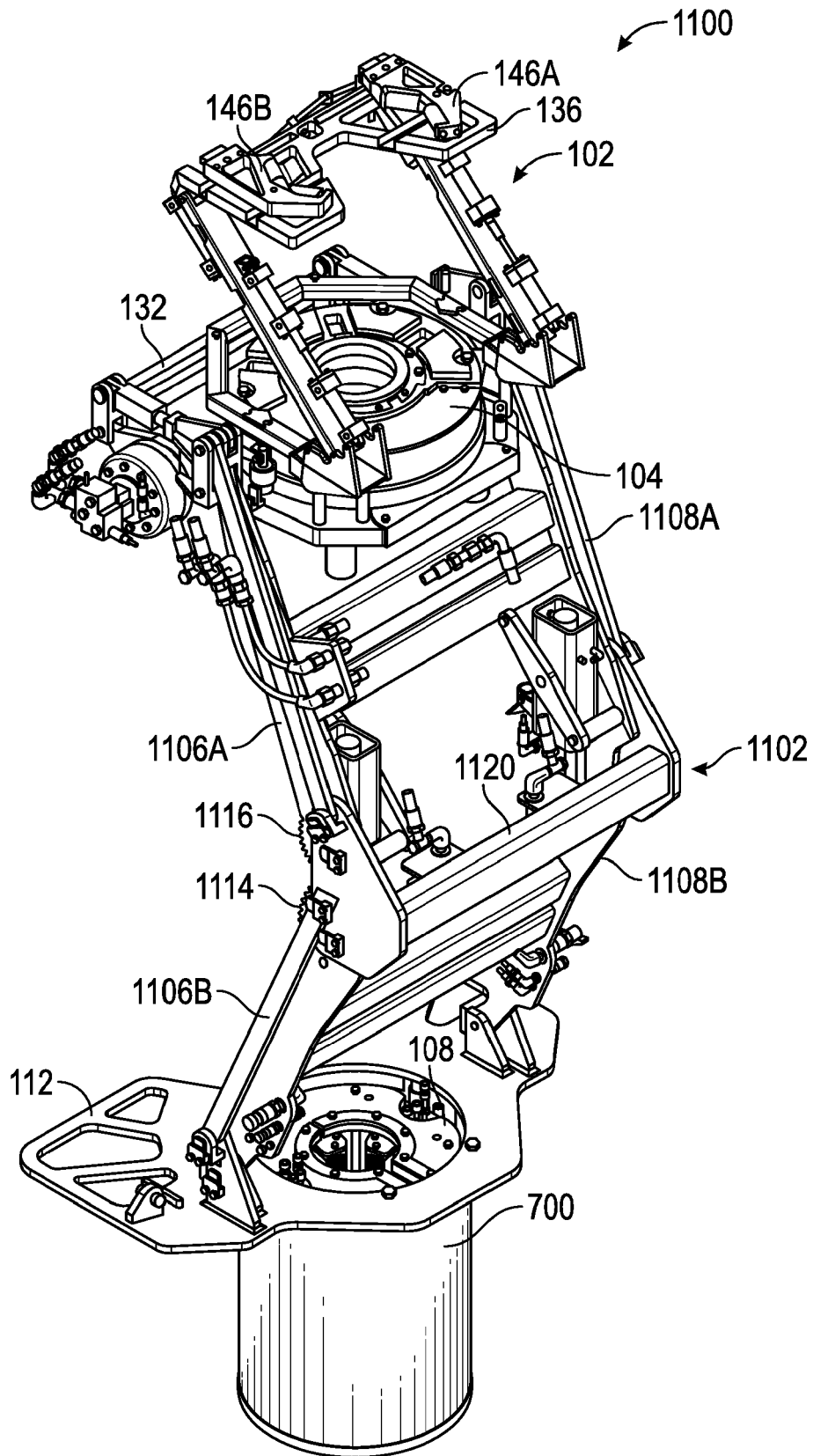


FIG. 9

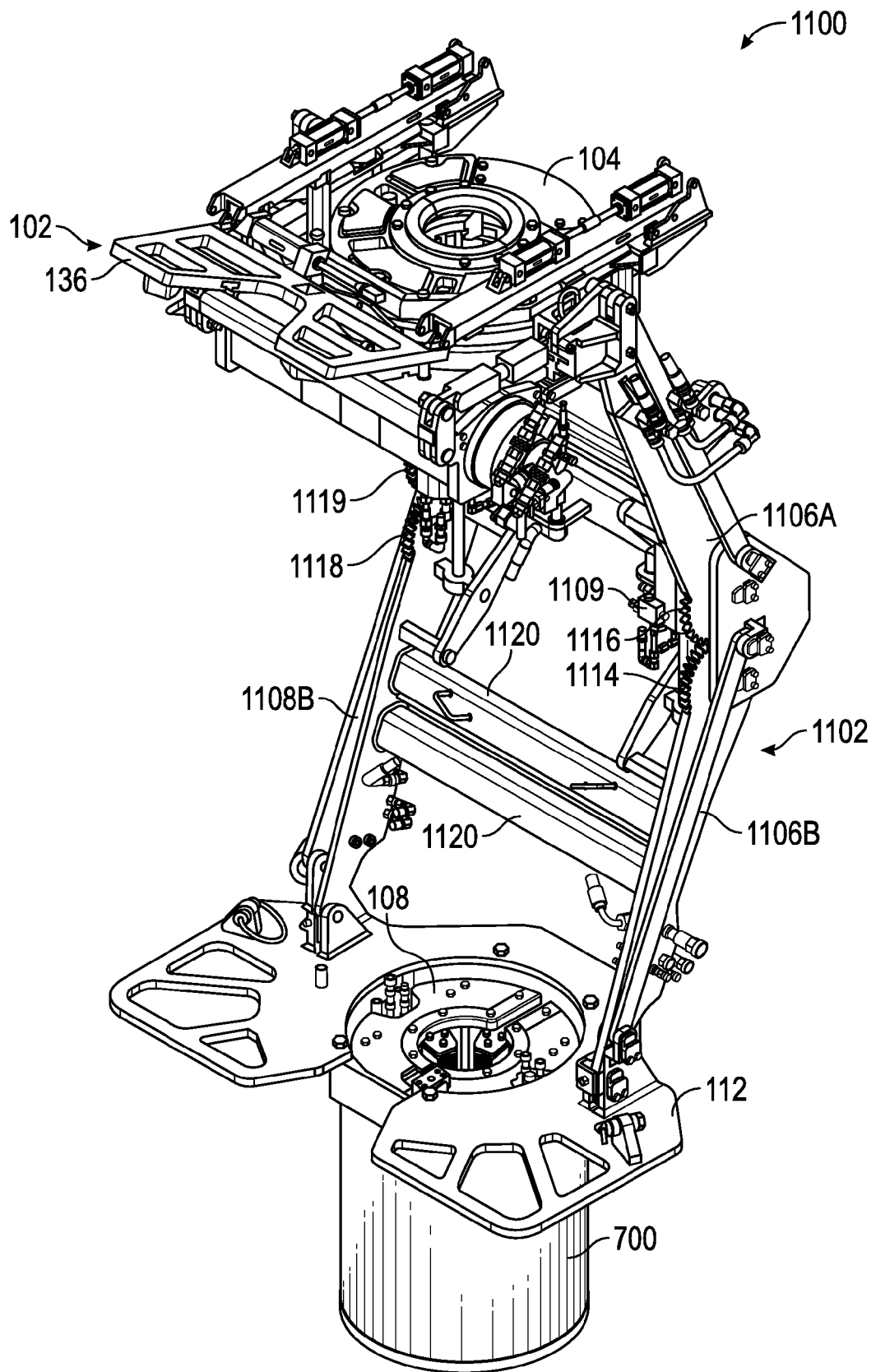


FIG. 10

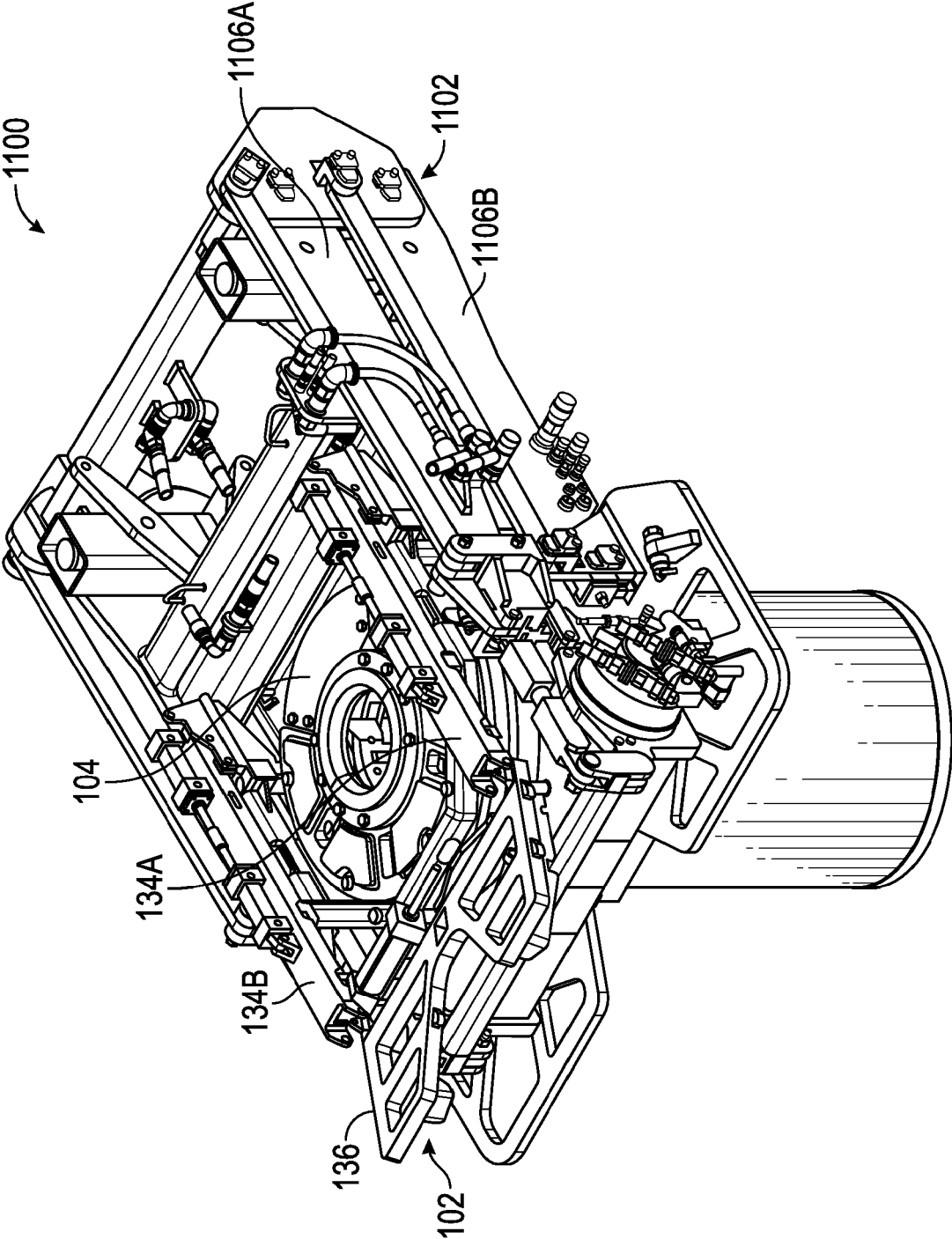


FIG. 11



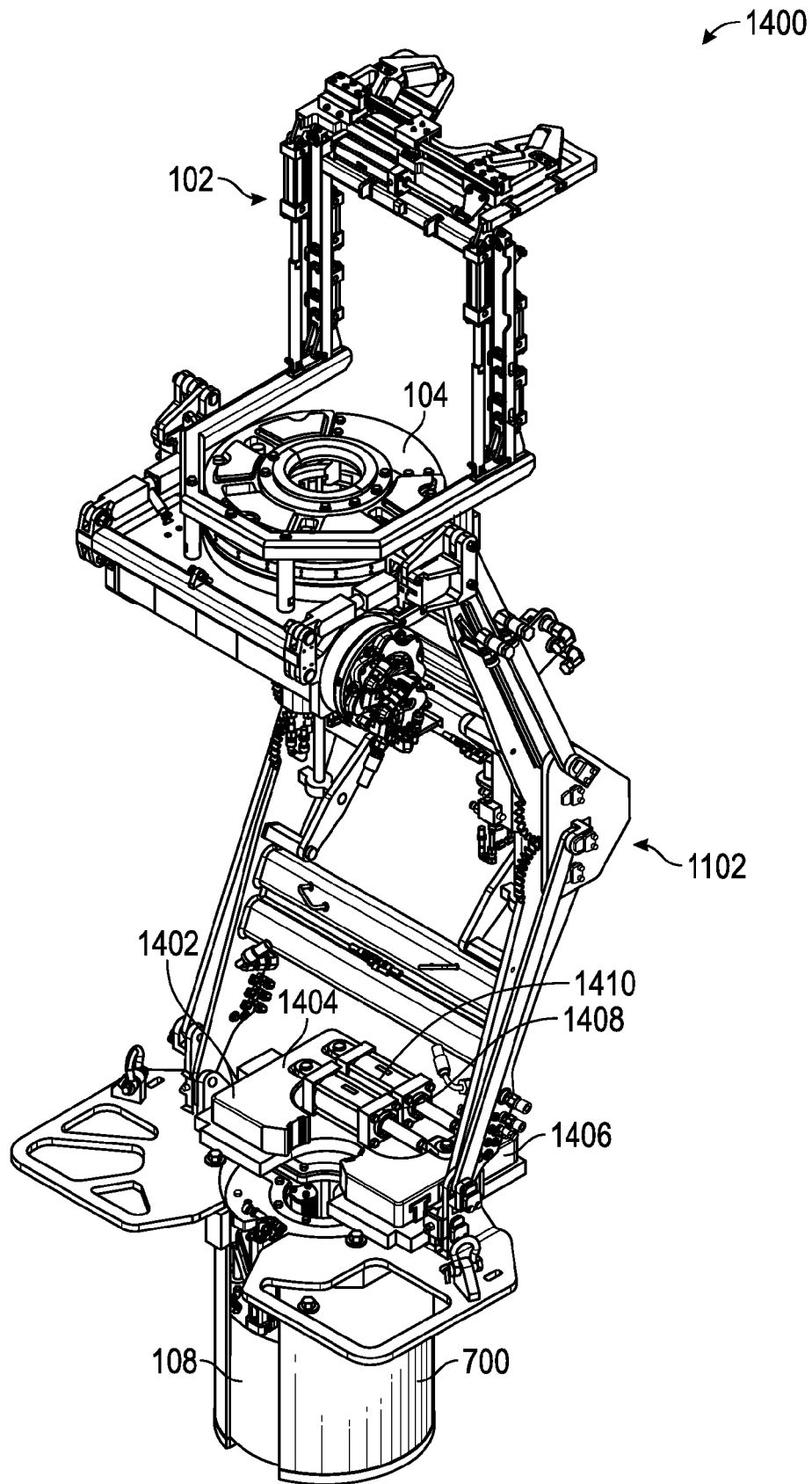


FIG. 12

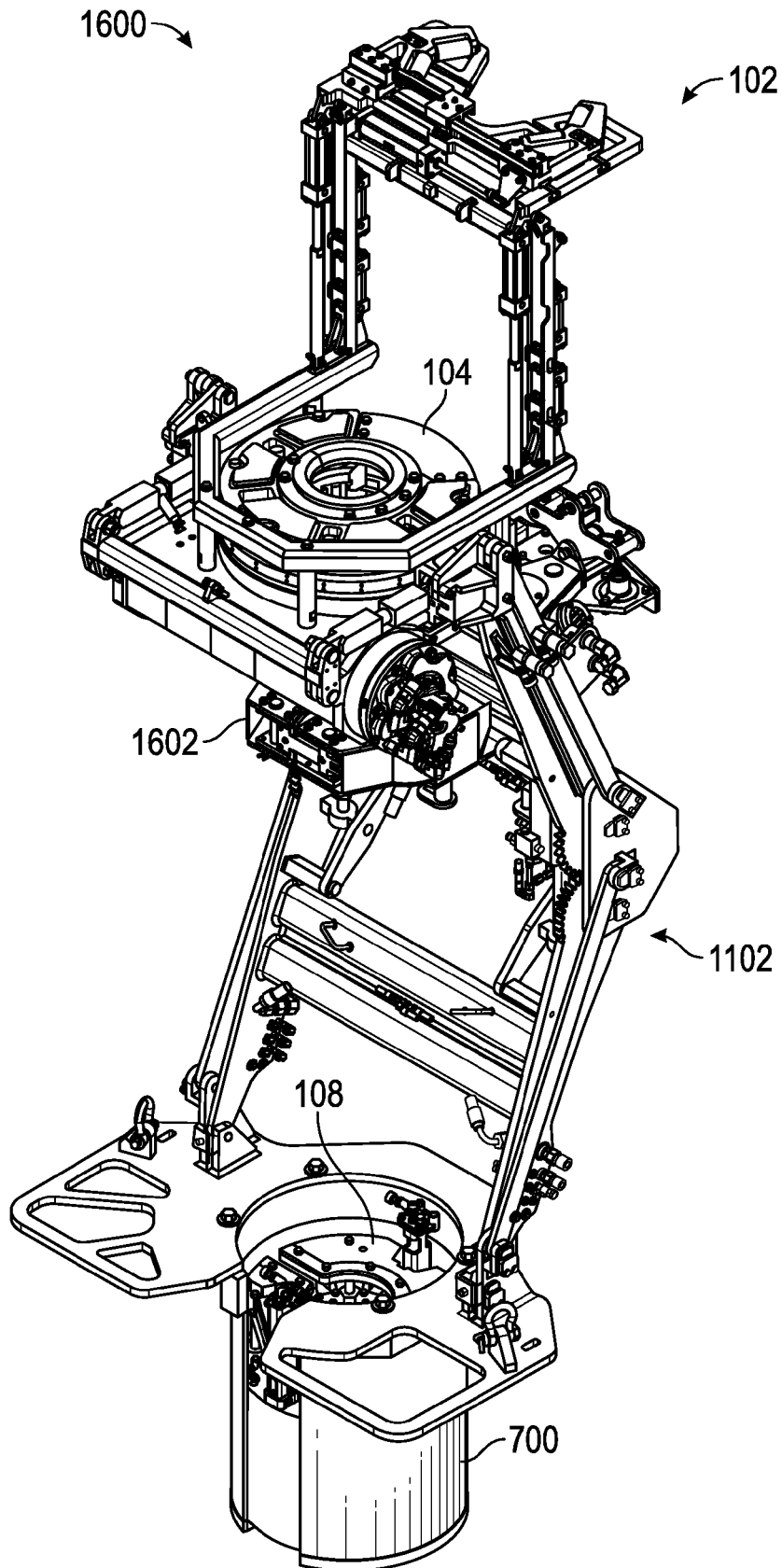


FIG. 13

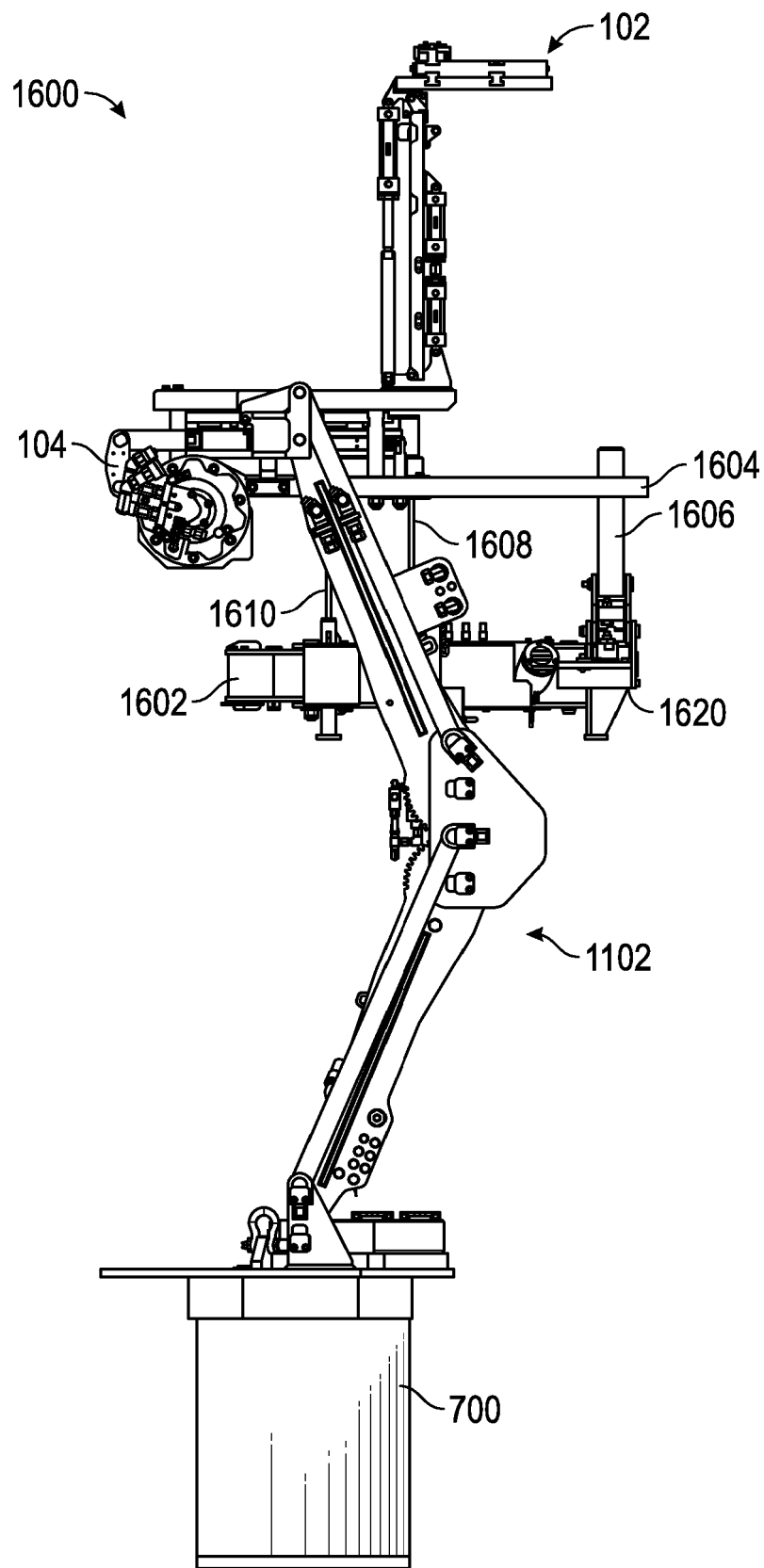


FIG. 14

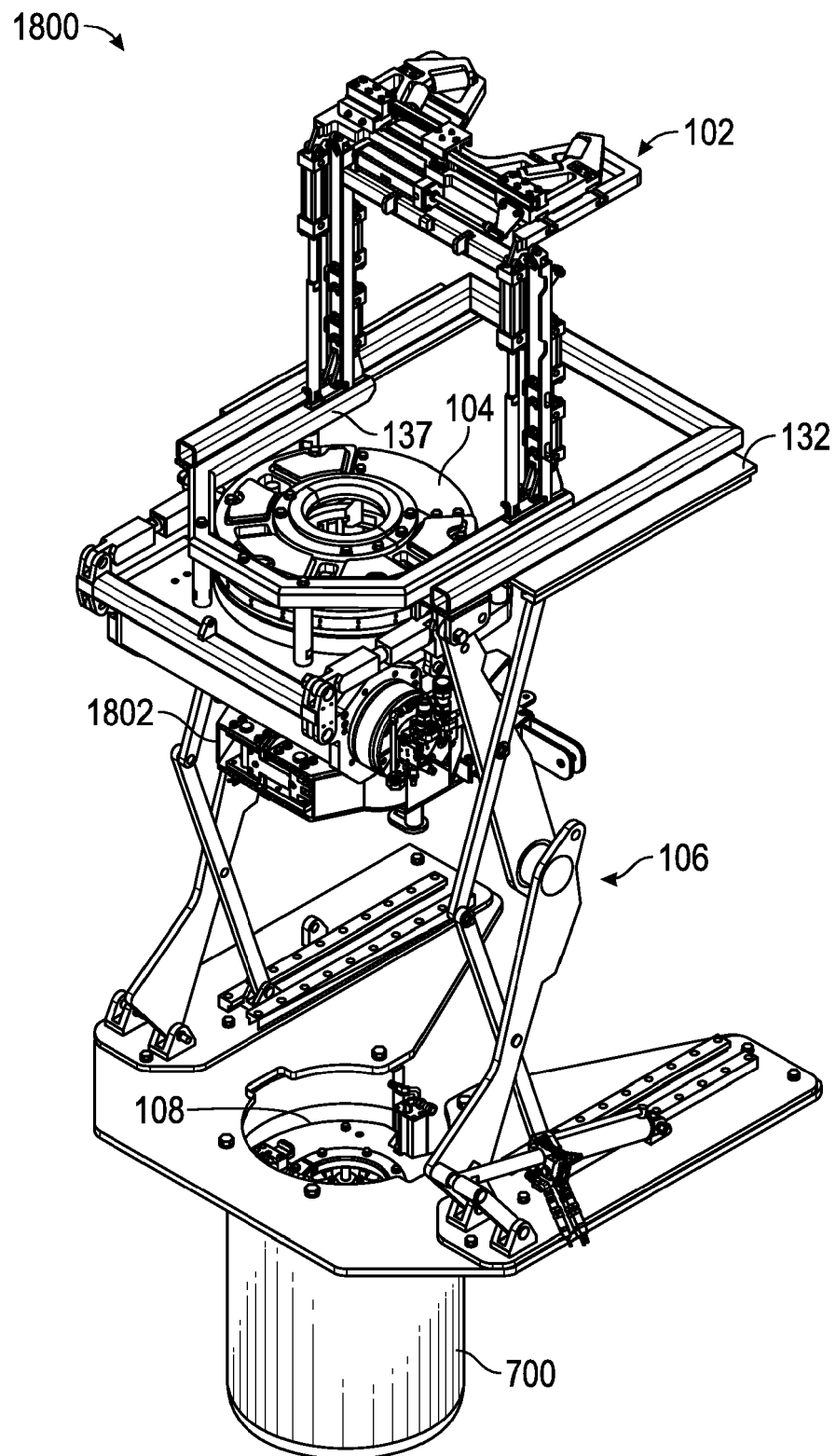


FIG. 15A

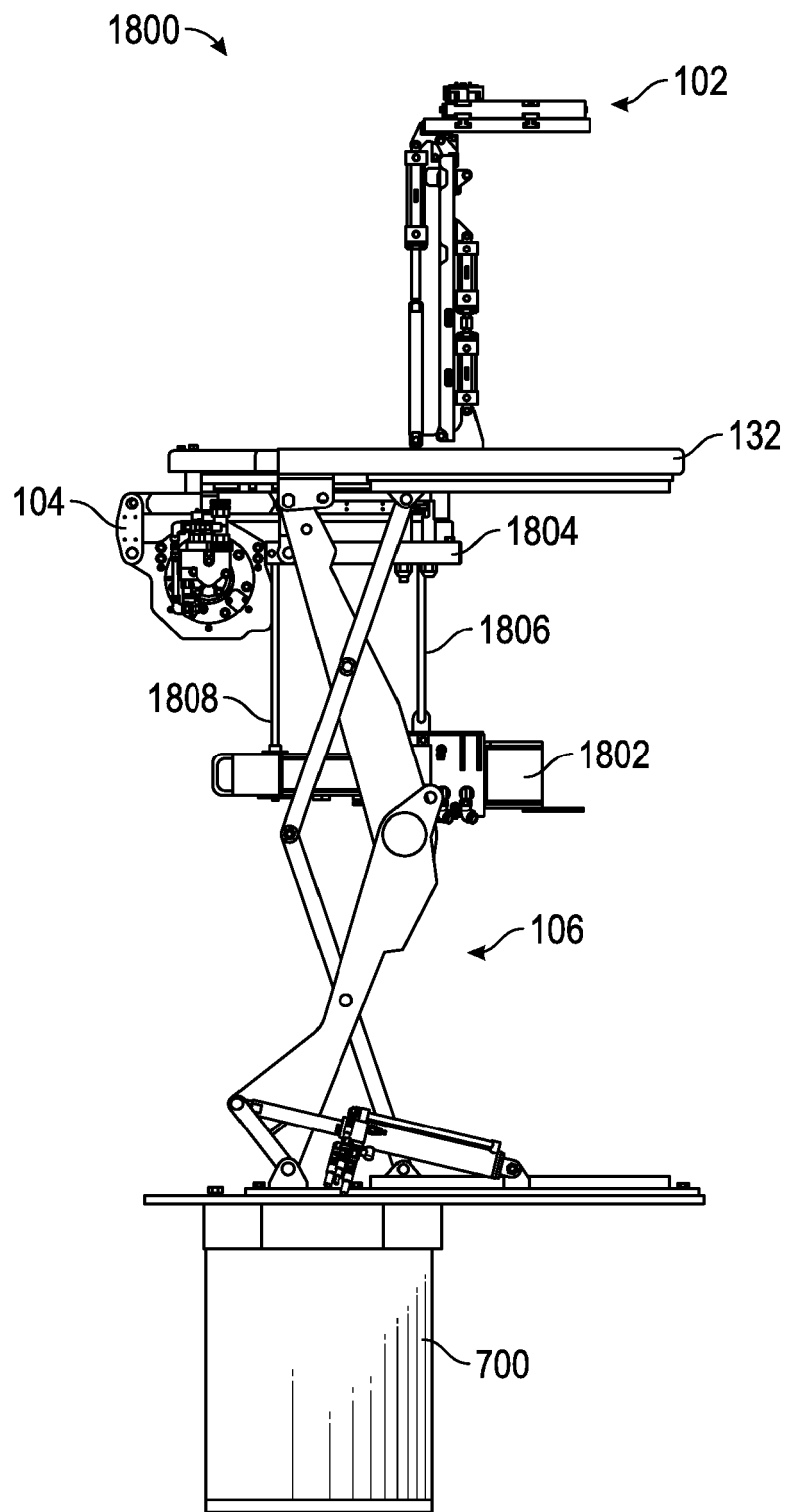


FIG. 15B

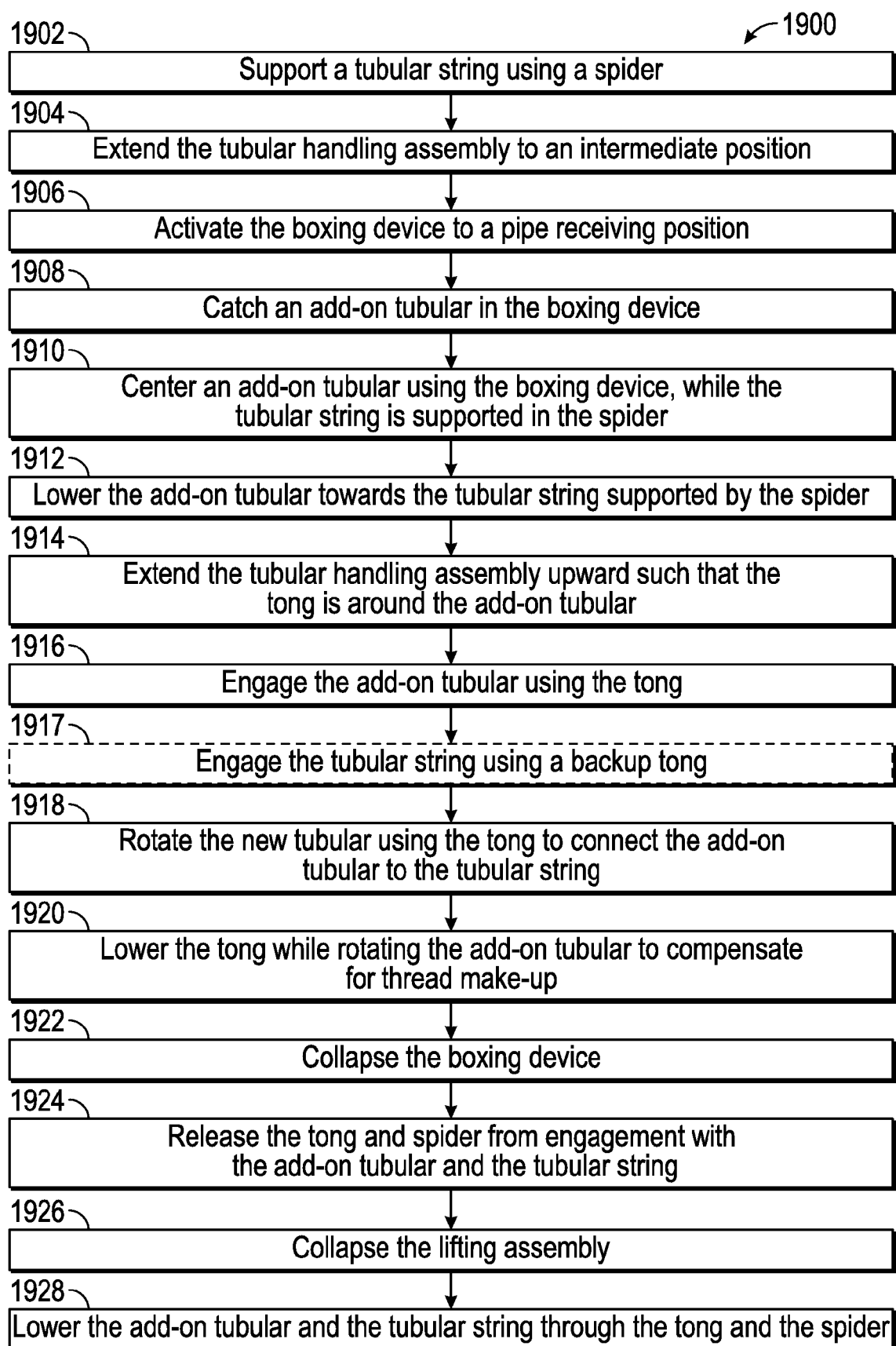
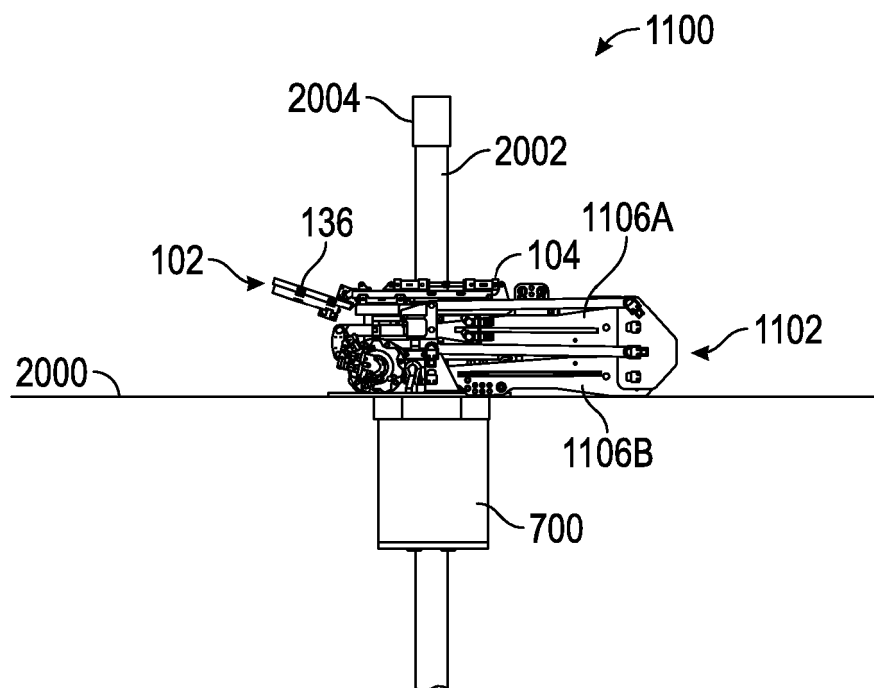


FIG. 16



**FIG. 17A**

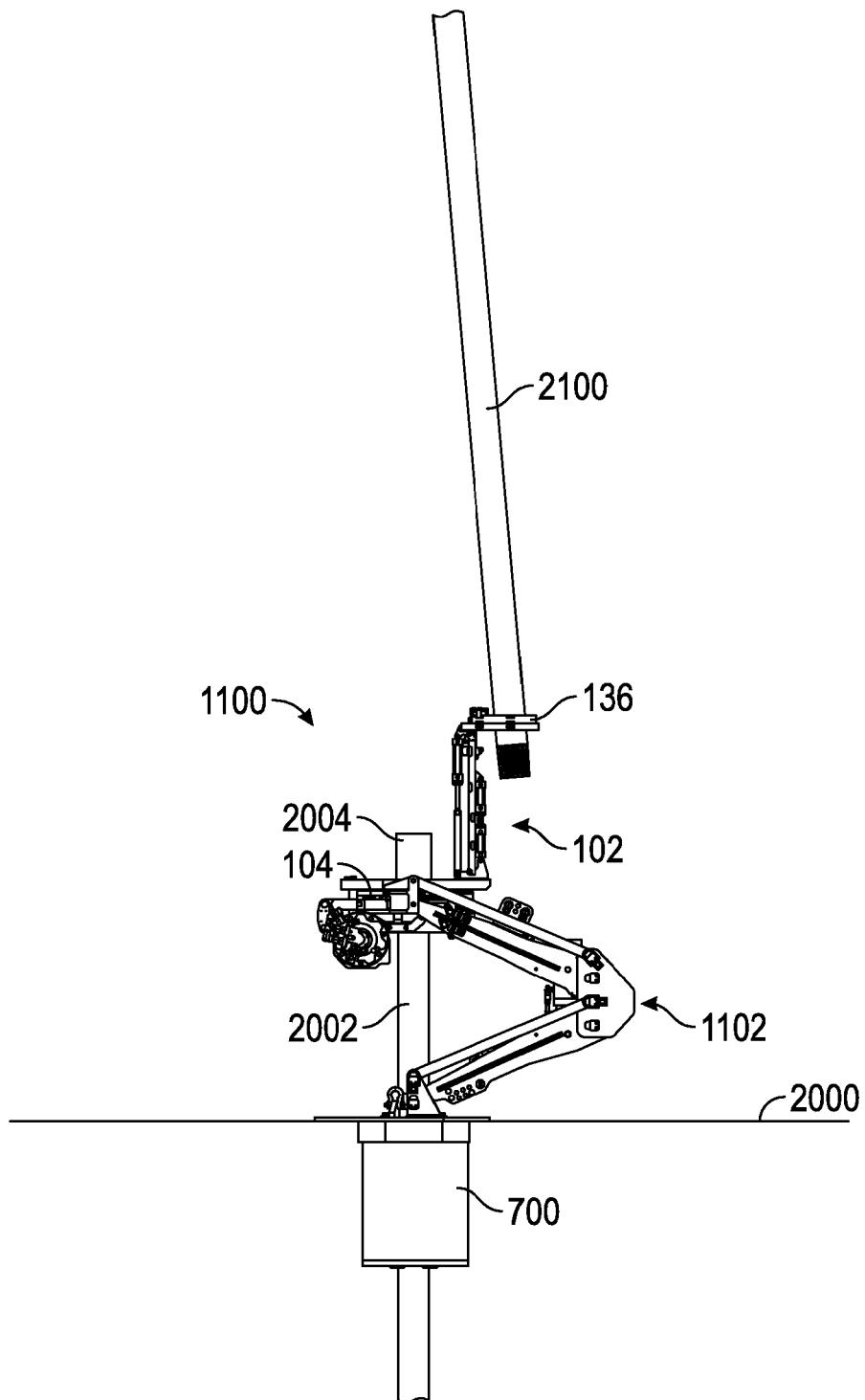


FIG. 17B



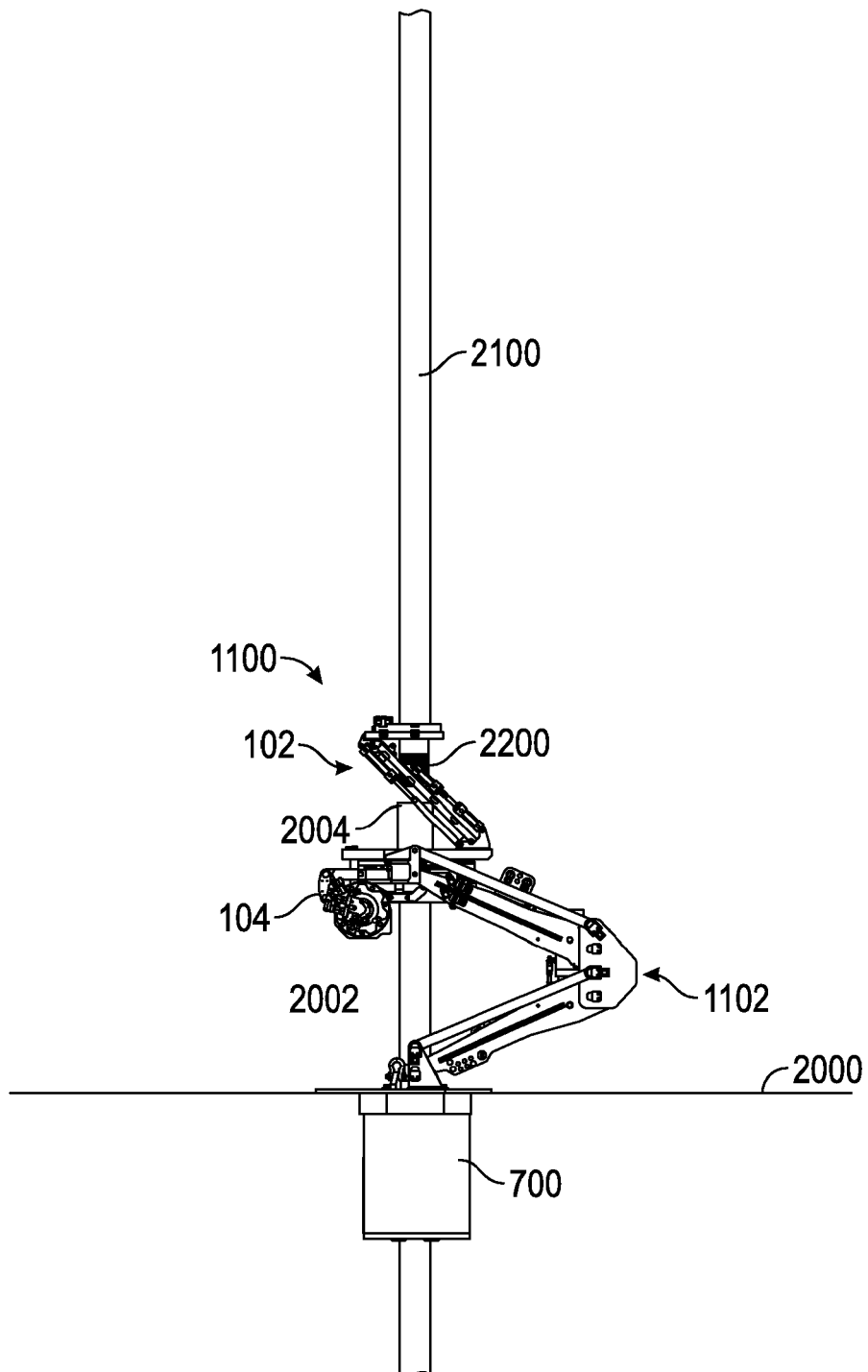


FIG. 17C

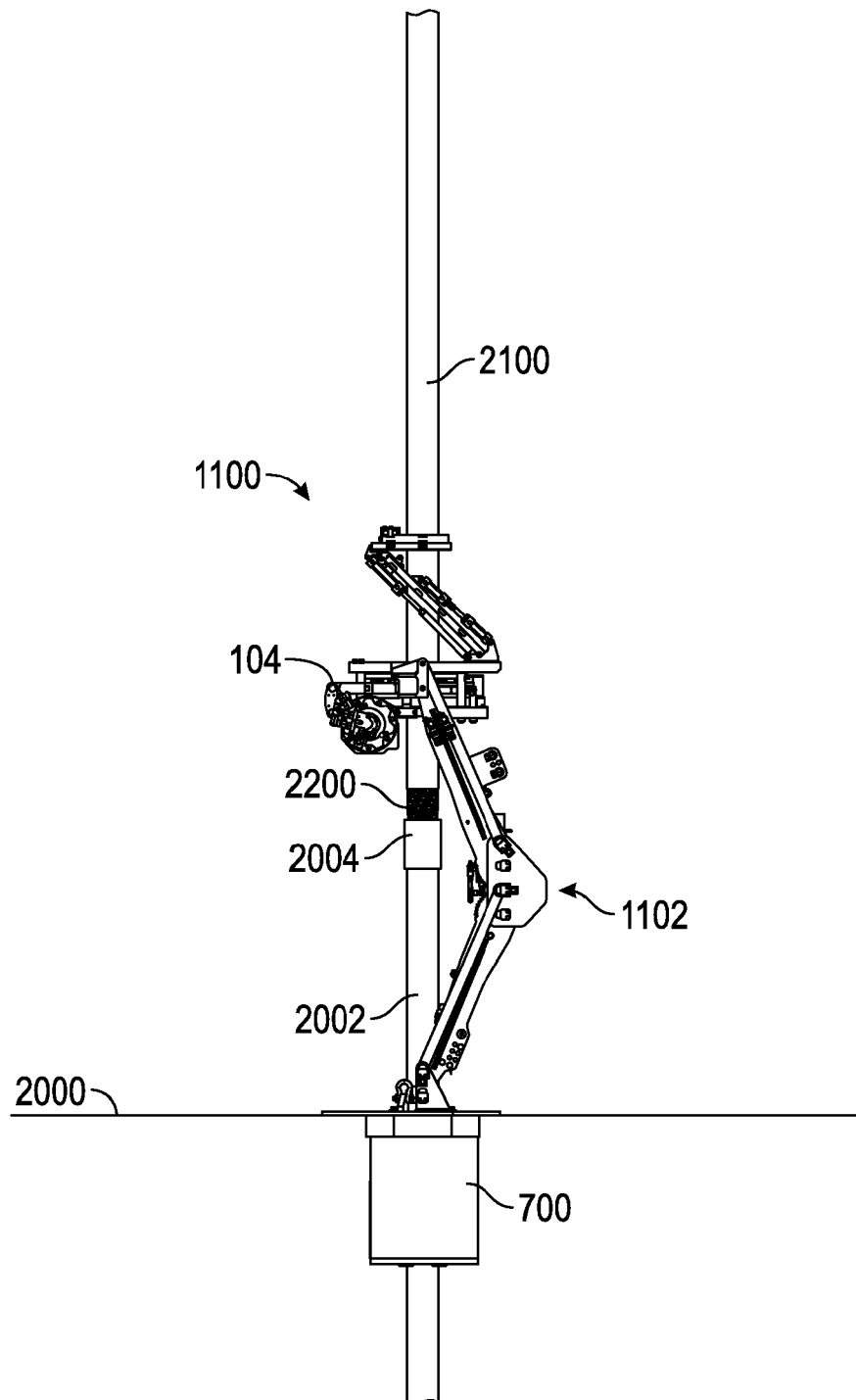


FIG. 17D

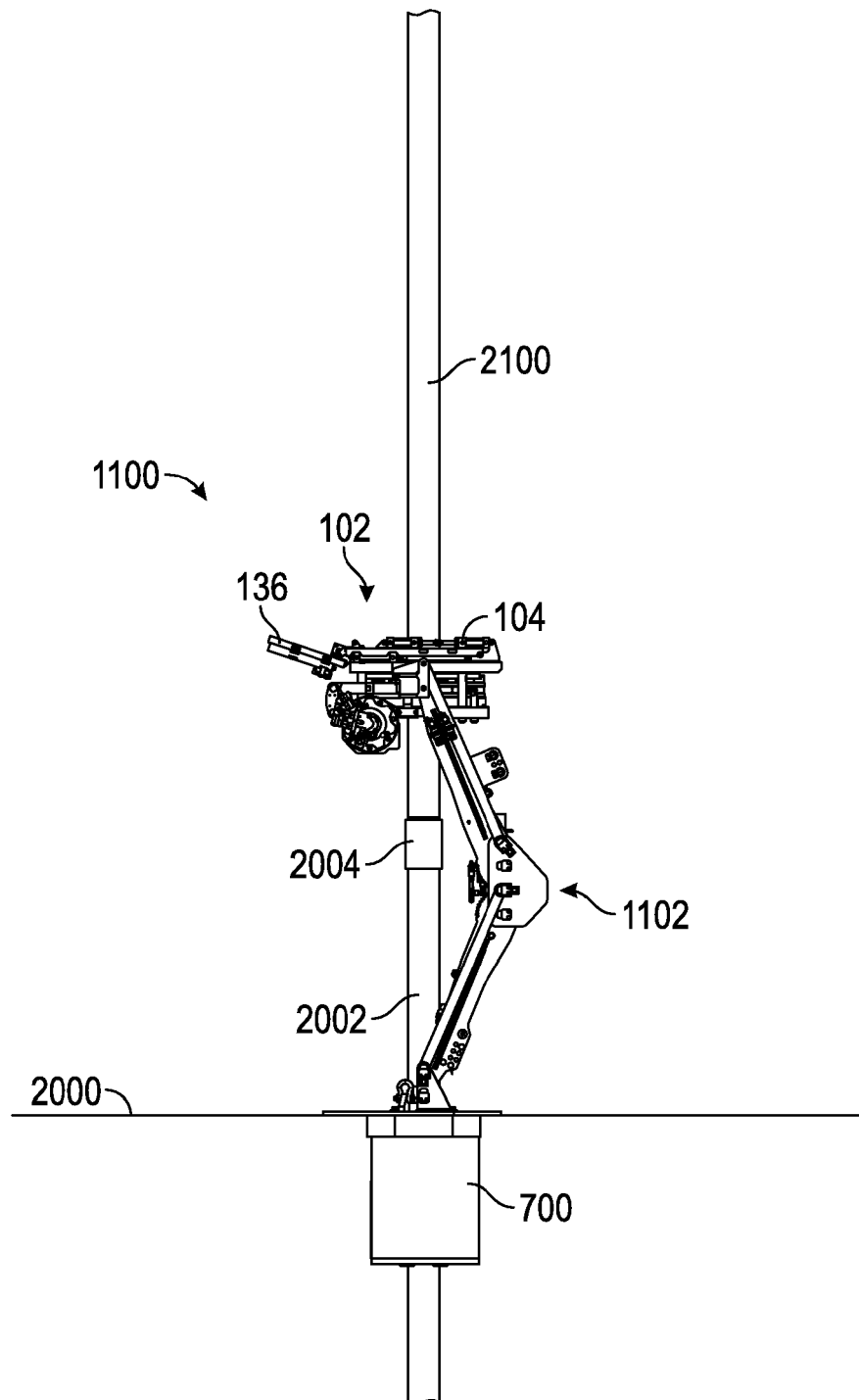


FIG. 17E

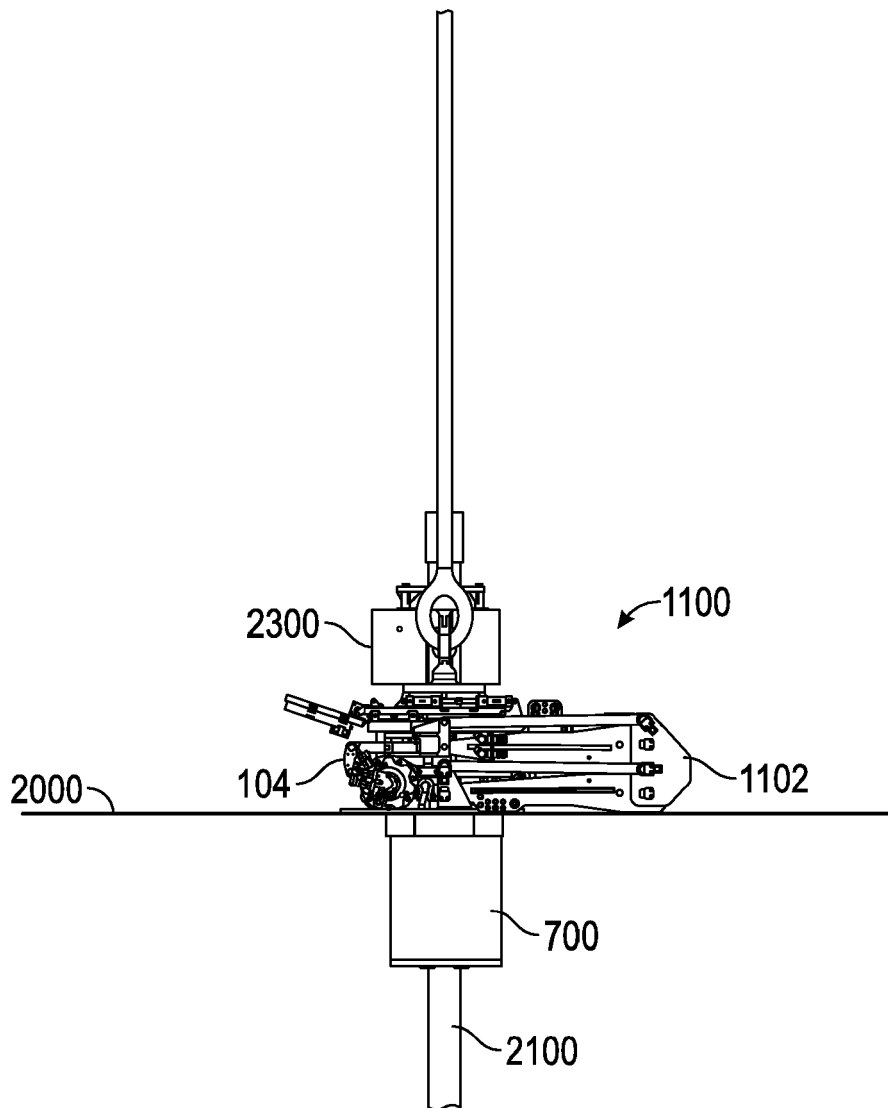


FIG. 17F



## EUROPEAN SEARCH REPORT

 Application Number  
EP 20 20 6851

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 664 310 A (PENISSON DENNIS J [US]) 9 September 1997 (1997-09-09) * column 4, line 3 - column 6, line 12; figures 1-3 *	1-6, 9-11,15	INV. E21B7/20 E21B19/08 E21B19/16
X	WO 2015/061350 A1 (FRANK S INT LLC [US]) 30 April 2015 (2015-04-30) * paragraphs [0091] - [0093], [0107]; figures 1,9,10 *	1,7-9, 12-14	
X	US 6 223 629 B1 (BANGERT DANIEL S [US]) 1 May 2001 (2001-05-01) * column 8, line 51 - column 9, line 2; figure 2 *	1,9	
A	US 6 814 149 B2 (WEATHERFORD LAMB [US]) 9 November 2004 (2004-11-09) * column 10, line 40 - column 11, line 56; figure 18 *	1-15	
A	US 2014/116687 A1 (RUEHMANN RAINER [DE]) 1 May 2014 (2014-05-01) * paragraph [0036]; figure 3a *	1-15	TECHNICAL FIELDS SEARCHED (IPC) E21B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 1 February 2021	Examiner Strømme, Henrik
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

 1  
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 20 20 6851

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
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20

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30

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Patent document cited in search report		Publication date	Patent family member(s)			Publication date
US 5664310	A	09-09-1997	CA	2179357	A1	24-12-1996
			GB	2302516	A	22-01-1997
			NO	308806	B1	30-10-2000
			US	5664310	A	09-09-1997
-----						
WO 2015061350	A1	30-04-2015	US	2015107850	A1	23-04-2015
			WO	2015061350	A1	30-04-2015
-----						
US 6223629	B1	01-05-2001	CA	2368528	A1	18-07-2003
			DK	1212172	T3	17-09-2007
			EP	1212172	A1	12-06-2002
			NO	323655	B1	18-06-2007
			US	6223629	B1	01-05-2001
			WO	0103889	A1	18-01-2001
-----						
US 6814149	B2	09-11-2004	AU	2003212901	A1	04-09-2003
			CA	2476189	A1	21-08-2003
			EP	1474588	A2	10-11-2004
			EP	2264276	A2	22-12-2010
			NO	336292	B1	13-07-2015
			US	2002189804	A1	19-12-2002
			WO	03069113	A2	21-08-2003
-----						
US 2014116687	A1	01-05-2014	AU	2013337757	A1	23-04-2015
			CA	2886984	A1	08-05-2014
			EP	2917453	A2	16-09-2015
			US	2014116687	A1	01-05-2014
			WO	2014071056	A2	08-05-2014
-----						

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- US 27389516 [0001]